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How Connectedness to Nature Relates to Well-Being over Time

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Abstract

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Correlational and experimental studies have found evidence that connectedness to nature (CN) leads to increases in well-being. Higher CN relates to higher positive affect, lower negative affect, and better health (Herzog & Strevey, 2008; Korpela & Ylen, 2007; Mayer, Frantz, Bruehlman-Senecal, & Dolliver, 2009). Little research, though, has examined the relation of CN and well-being over time. With the lack of longitudinal data, it is impossible to assess how CN might be associated with well-being and health over a person's lifetime. This study is among the first to evaluate CN and well-being with three-time points. Final analyses were conducted on three times of measurement with sample sizes varying from 152 to 77. It was found that CN is a stable construct over time, with correlations ranging from r = .78 to r = .85. To further corroborate the evidence of stability, repeated measures analysis of variance show no significant differences between waves of CN, F (1, 60) = .45, p = .51. It was also found that CN was positively related to positive affect over time, with correlations ranging from r = .28 to r = .31. Lastly, it was found that covariates of age, gender, and location contribute to CN and the CN and well-being relation. This study advances the field in four important ways. First, the evidence shows that CN is related to well-being. Second, the evidence shows stability in CN, over at least a 2-year period. Third, predictors like age, gender, and location play a role in the examination of CN and well-being. Lastly, the current evidence shows support for both broaden-and-build and the ecological self theory in defining the CN and well-being relations.

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Introduction

Human beings are part of the natural world and often feel a need to interact with nature. In fact, even children as young as age five report the need to be in and interact with the environment (Levin & Unsworth, 2013). Additionally, many people experience health benefits from interacting with the natural environment (Kaplan & Kaplan, 2011; Mayer, Frantz, Bruehlman-Senecal, & Dolliver, 2009). For example, exposure to the natural world increases positive states (e.g., mood, cognition) and decreases negative ones (e.g., stress, depression, cognitive fatigue; Mayer et al., 2009). For individuals with cognitive or emotional impairments, interacting with the natural world may have restorative effects (Kaplan, 1995).

With research showing the positive outcomes from spending time in nature, one might expect that more people would spend time outside and build a stronger connection with nature (Mayer et al., 2009). However, recent cohorts are spending less time outdoors and more time indoors (Grinde & Patil, 2009), which has renewed interest in studying how less time spent outside may be related to health and well-being. Concomitantly, there is an increased research and intervention focus on ways to improve emotional and subjective physical well-being, with the general approach having people spend more time with the natural world and encouraging them to connect with that environment. Thus, understanding how the emotional connection with the natural environment relates to health and well-being is a crucial area of research.

Well-Being

Well-being is a multifaceted and multidimensional construct, which includes objective and subjective physical health and quality of life (Lawton, Moss, Flucomer, & Kleban, 1982). Other conceptualizations, such as the PERMA model (Forgeard, Jayawickreme, Kern, &

Seligman, 2011; Seligman, 2011) include a broader array of dimensions, including positive emotions, engagement in meaningful activities, interpersonal relationships, purpose in life, and a sense of accomplishment. These broader aspects sometimes differ in their importance and interrelations at different points in the lifespan (Kern, Waters, Adler, & White, 2015). Despite the fact that there are such differences in the conceptualizations of well-being, both physical and emotional well-being emerge as primary components. A recent meta-analysis (Diener & Chan, 2011) supports the interconnections among mortality risk, emotional well-being, and physical health. However, other research suggests more nuanced relations (Friedman & Kern, 2014; La Placa, McNaught, & Knight, 2013). Thus, understanding mechanisms and correlates that support improved subjective physical and emotional well-being is an important endeavor.

Subjective physical well-being is usually indexed through a person’s assessment and satisfaction with their current health and functioning (Lawton, et al. 1982; Ware, Kosinski, & Keller, 1996), which relates to future well-being. Subjective assessments and self-reports of physical health may predict morbidity and mortality better than more objective assessments (Graf & Patrick, 2016; Idler & Benyamini, 1997; Jylhä, 2009). Among the most-used indices of subjective physical health is the SF-12, which is often referred to as the ‘gold standard’ of self-assessed health (Ware et al., 1996). The SF12 is a multidimensional measure that includes global subjective assessments of health and physical functioning, and how health affects daily activities.

Emotional well-being often includes measures of satisfaction with life, positive affect, and negative affect (Diener, Suh, Lucas, & Smith, 1999). Satisfaction with life is a global index of one’s overall evaluation of their quality of life (Diener, Emmons, Larson, & Griffin, 1985). Because affect is comprised of both positively and negatively valenced emotions, it should be assessed as two separate factors (Bradburn & Caplovitz, 1965). Positive affect includes happiness, contentment, and activity levels. Negative affect often includes feelings of anxiety, depression, and hostility (Lawton, Kleban, Dean, Rajagopal, and Parmelee, 1992).

Levels of well-being change over the lifespan and physical health often declines, with noticeable changes in midlife (Lachman, 2004). Also, middle-aged and older adults often report higher ratings in emotional well-being compared to subjective physical well-being (Kostka & Bogus, 2007). Emotional well-being has been shown to change over the lifespan, with an increase in positive affect and a decrease in negative affect (Carstensen, 1995). An emerging research focus is on the interplay of physical and emotional well-being, as well as on moderators of these associations. For example, recent evidence suggests that even more so than chronological age, individual difference factors like time perspective (Stahl & Patrick, 2012) and willingness to pursue health-related and emotion-related behavior change (Knepple Carney & Patrick, 2017) predict health behaviors, which may be key determinants of physical health.

Connectedness to Nature

Connectedness to Nature (CN) is an individual difference characteristic that includes one's affective and experiential sense of belonging to the natural world (Mayer et al., 2009). Research in CN has focused on precursors of its development and the broader effects of CN on well-being. Regarding the development of CN, the sense of belonging that people feel can come from exposure, interaction, and/or an emotional bond to the natural environment. Although primarily examined in the ecological psychology field (Hinds & Sparks, 2009; Kaplan, 1995), CN relates to lifespan theories, as well. For example, CN can range from how a person thinks about themselves in terms of nature (e.g. identity and ecological self; Bragg, 1996), how a person has an innate desire to be affiliated with the natural world (e.g., biophilia; Wilson, 1984), how positive emotions may encourage a cyclical exploration of nature (e.g., broaden-and-build;

Fredrickson, 2004), or how spending time in nature can help to restore cognitive abilities (e.g. attention restoration theory; Kaplan, 1995). Although compelling, the research on the development of CN is in its early stages and is hampered by circular reasoning and difficulty in isolating temporal order. The research evidence supporting an association between CN and well-being is much stronger. Though the CN and well-being literature is strong in cross-sectional research, little is known about their relation over time.

CN and Well-being

Interaction with the natural world may also be helpful for attenuating the physical health symptoms that people experience from stress. When asked about favorite places to visit when experiencing health issues (i.e., headaches, stomach pains, dizziness), adults (n= 211, $M_{age} = 40$) were significantly more likely to pick natural places, over human-made places (Korpela & Ylen, 2007). Most participants said that interacting with nature helped to reduce negative feelings, reduce stress, and increase positive emotions (49%). Respondents who reported interacting with nature also reported fewer headaches compared to those who did not interact with nature (Hansmann, Hug, & Seeland, 2007). With many people using and thinking about using nature as an escape from stress symptoms, it can be posited that those people have built a connection with nature, which helps them to escape. By interacting with nature, these participants felt like they were able to “get away” from daily frustrations. Thus, interacting with nature may confer stress-reduction and tension-reduction benefits (Herzog & Strevey, 2008). That interaction also leads people to build a connection with nature, so they remember to use it again for all those positive benefits.

Interacting with nature might also build and sustain positive affect. The broaden-and-build theory proposes that as people experience positive emotions, they are encouraged to broaden their actions (Fredrickson, 2004). These positive emotions inspire the exploration of new experiences and ideas. The new experiences and ideas then build that person’s resources to be able to deal with challenges they may face later. By experiencing positive affect while interacting with nature, a person may be encouraged to explore more of the natural world. Those new explorations may further help the person to develop a connection on which they can rely on in the future. In essence, there may be a cyclical relationship between nature and well-being. This hypothesis is relatively unexamined in the literature.

A stable correlation has been identified between CN and well-being. For example, a recent meta-analysis of 30 samples totaling more than 8,500 people supports small significant effects of CN on emotional well-being, with an overall effect of $r = .19$. Associations with vitality ($r = .24$), positive affect ($r = .22$), happiness ($r = .18$) and life satisfaction ($r = .17$) are evident (Capaldi, Dopko, & Zelenski, 2014). Even living near green spaces seems to be associated with boosts in well-being. People who lived within a 1km radius of green spaces had significantly fewer diseases compared to those who lived further away (Maas et al., 2009).

Researchers have recently begun to examine the stability of CN over time (Korpela & Ylen, 2007). Although only a handful of studies have used repeated measures designs to study CN, there are suggestions for stability. In a two year study, with two times of measurement, it was determined that attitudes towards the environment were stable (Kaiser, Brügger, Hartig, Bogner, & Gutscher, 2014). Similarly, Schultz and colleagues showed the stability of attitudes toward nature across a 4-week period, using 2-time points (Schultz, Shriver, Tabanico, & Khazian, 2004). Although these constructs may be related to CN, only one study has explicitly examined the stability of CN over time. Using an abbreviated scale assessing both affective and experiential aspects of CN, Nisbet and Zelenski (2013) found stability over a one-month period

($r > .80$). However, using only two points of measurement is not sufficient to examine the stability of a construct over time, and the only way to examine if there is consistency or change is through at least three-time points (Singer & Willet, 2003).

In an experimental study, undergraduates took a walk in the woods, a walk in a city, or watched videos of nature (Mayer et al., 2009). Participants who were exposed to the natural environment had increased CN, increased positive affect, could focus their attention more fully, and had greater ability to focus on life's problems, compared to those who walked in the city. These results were significant for both those walking in nature and watching nature videos. However, physically being in nature had the greatest effect. When a person spends time in nature, they get the direct physical interaction benefits, such as restoration, but they may also develop a deeper emotional connection, which may lead to longer-lasting positive impacts. Some people may have an identity that is compatible with nature, and the deeper the connection they develop with nature may affect how they identify with nature.

The ecological self is part of a person's identity that extends beyond the individual self and includes something broader. Ecological self is a sense of self that includes an interaction with all other life-forms (i.e., plants, animals). Through this interaction with other life-forms, people develop an emotional connection and a relatedness in which a person has a perception of being similar to other living things, including the Earth (Bragg, 1996). The notion that humans and living things are similar has been established in research, where participants had to classify items (e.g., self, nature, built items, and others) into the categories that they belong. It was found that people classify self and nature items faster than the other categories and they had a greater propensity to view nature and self-items more positively (Verges & Duffy, 2010). Part of how we understand CN may be based on how the natural world fits into our self-concept or identity

(Bragg, 1996). An ecological self is one that identifies with the natural world and the interests of the environment are our interests; it becomes possible to expand a person's sense of self from individual to ecological (Naess, 1988). Due to the close connection with nature and its life-forms, one's self-identity blurs with that of an ecological-identity, resulting in a lack of differentiation between the natural world and self.

The link between CN and well-being has been highlighted within the therapeutic context (Blair, 2011). Spending time in nature may be an inexpensive intervention strategy to help improve emotional health (Pryor, Townsend, Maller, & Field, 2007). CN has been used in multiple interventions to help reduce unhelpful anxiety and increase well-being. Pryor and colleagues (2007) reported on the experiences of seven women who, as part of a drug treatment intervention, spent time outdoors. These women improved both their physical health and emotional well-being, separately, by building a connection with nature (Pryor et al., 2007). The reason CN may be effective is that it provides a way to relax, allows people to take a "time out," provides enjoyment and a way to connect, and allows for sensory engagement (Martyn & Brymer, 2016). This study shows an association between improved health and CN in women, but few studies have studied the effect of CN as it relates to gender.

Moderators of the CN to Well-being Relation

There is suggestive evidence for the stability of CN over short periods of time, and there is evidence of the concurrent associations between CN and well-being (Han, 2008; Mayer & Frantz, 2004; Nisbet & Zelenski, 2013). What is not known are the potential moderators of the CN to well-being relation. Examining for whom interacting with nature improves well-being is the next logical step in this line of inquiry. As an initial foray, other individual difference factors, such as age, gender, and place of residence, should be examined.

Cross-sectional research examining one age group at a time has shown that higher CN correlates with positive well-being across different age groups (Bisceglia, Perlman, Schaack, & Jenkins, 2009; Han, 2008, Mayer et al., 2009). It is unclear whether this association for CN and well-being differs in strength or magnitude across age groups. The research conducted in CN has been cross-sectional, usually with one age group. Even when the study has a diverse sample, the researchers do not assess the association between age and CN (Korpela & Ylen, 2007). Understanding the association between CN and age will help to establish the benefits people may receive from this connection.

Gender might also be a moderator of the CN to well-being relation. Multiple studies report that relative to men, women: engage in more frequent environmentally sound behaviors (Mayer & Frantz, 2004; Zelezny, Chua, & Aldrich, 2000), exhibit more engagement with beauty (Diessner, Solom, Frost, Parsons, & Davidson, 2008), and report more stress reduction as a result of spending time in nature (Kim & Mattson, 2002). However, only one study directly examined gender differences in CN and no significant gender differences emerged (Mayer & Frantz, 2004). Thus, it is unclear how gender relates to the relation between CN and well-being.

The role of the broader environment on well-being is a research area that is gaining attention (Knepple Carney, Turiano, & Patrick, 2017), in that both well-being and neighborhood quality change conjointly over time. Studies have shown that people who live in rural areas differ significantly in their CN compared to people who live in urban areas. Rural participants were more connected and engaged with nature more than urban participants (Bunting & Cousins, 1985; Hinds & Sparks, 2008). To further complicate this issue, it has been found that spending time in urban green spaces in a temperate climate increased well-being, but spending time in a tropical city did not increase well-being (Saw, Lim, & Carrasco, 2015). However, few studies have assessed whether participant location has an impact on CN or well-being.

Current Study

Through correlational and experimental studies, there is evidence that CN leads to increases in well-being. Higher CN relates to higher positive affect, lower negative affect, and better health (Herzog & Strevey, 2008; Korpela & Ylen, 2007; Mayer, Frantz, Bruehlman-Senecal, & Dolliver, 2009). What is not well understood is how they relate over time. With the lack of longitudinal data, researchers cannot assess the stability or change of CN and how that might be associated with well-being and health over a person's lifetime. The current research helped by adding longitudinal data to the understanding of CN and well-being. By knowing how these constructs relate over time, it can be determined whether the benefits of CN on well-being are short-term or longer lasting. Also, few studies have found mixed results assessing how age, gender, and location relate to CN. By examining these three covariates in a longitudinal study, it can be determined what role they may play in a person's CN and well-being.

One of the major criticisms of past repeated measures work with CN is that it only assessed two-time points. To truly determine change, at least three-time points must be assessed (Singer & Willet, 2003). This study is among the first to evaluate CN and well-being with three-time points. The current study examined stability or change between the constructs, as well as time-ordered causation. By using both ecological self theory and broaden-and-build theory, this study determined if one theory fits the association of CN and well-being better or if both theories explain the association.

Hypotheses and Research Questions

Hypothesis 1: Cross-sectional hypotheses and research questions. CN would be positively associated with well-being.

Hypothesis 1A: Based on previous research showing that CN is associated with emotional well-being (Mayer et al., 2009), it was hypothesized that greater CN would be associated with higher positive affect, lower negative affect, and higher life satisfaction. This hypothesis was tested using data from wave 1, wave 2, and wave 3. A series of Pearson and Spearman correlations were computed among CN, positive affect, negative affect, and life satisfaction to examine the cross-sectional associations.

Hypothesis 1B: Previous research has shown that greater CN has been associated with lower diseases and reduced headaches (Maas et al., 2009). It was hypothesized that greater CN would be associated with better subjective health. This hypothesis was tested by examining the correlations between CN and subjective health within each time of measurement. Pearson correlations were conducted between CN and subjective health to examine the cross-sectional association.

Research Question 1: **What is the strength and magnitude of the association between CN and a variety of individual difference factors?**

Research Question 1A: No empirical information has been reported regarding whether CN is associated with age or differs by age. Thus, a Pearson correlation was conducted to assess the association between CN and age at waves 1, 2, and 3 to examine the cross-sectional association. To further address this question, mean age differences were examined using multiple 1-way Analysis of Variance (ANOVAs).

Research Question 1B: Studies assessing gender have found mixed results regarding the association between gender and CN. Therefore, the association of gender and CN were examined. A Spearman rho correlation was computed to examine the association between CN and gender. To further examine mean gender differences, ANOVAs were conducted.

Research Question 1C: Evidence shows that growing up in rural areas (Hinds & Sparks, 2008) or temperate regions (Saw et al., 2015) is associated with higher CN compared to living in urban or tropical areas. Although, no research has examined the differences in CN among adults living in different geographical areas. For categorical indexes of location, a Spearman's rho coefficient was computed to examine associations with CN. To further address this question, ANOVAs were conducted with data from waves 1, 2, and 3 to examine the mean differences in CN between geographical locales.

Research Question 2: Waves 1, 2, 3 (2015, 2016, 2017). Assessing how CN and well-being change or stay stable over time. No specific hypotheses were proposed on the stability or change of CN. Based on the principles of ecological self, it is proposed that CN is a part of a person's identity (Bragg, 1996). As that part of identity changes over time, other changes may occur. The few previous studies assessing constructs related to CN over time have had mixed results (Kaiser et al., 2014; Nisbet, Zelenski, & Murphy, 2010). Therefore no specific hypotheses were proposed on the stability or change of CN over time. Once stability or change was established for CN, it was then examined in conjunction with well-being. The following research questions were based on the idea that CN and both emotional and subjective physical well-being will change together over time.

Research Question 2A: To examine how CN and positive affect change or stay stable together over time, a growth curve model was proposed. To further address how CN and positive affect change or stay stable over time, repeated measures ANOVAs were examined.

Research Question 2B: To examine how CN and negative affect change or stay stable together over time, a growth curve model was proposed. To further address how CN and negative affect change or stay stable over time, repeated measures ANOVAs were examined.

Research Question 2C: To examine how CN and life satisfaction change or stay stable together over time, a growth curve model was proposed. To further address how CN and life satisfaction change or stay stable over time, repeated measures ANOVAs were examined.

Research Question 2D: To examine how CN and health change or stay stable together over time, a growth curve model was proposed. To further address how CN and subjective physical health change or stay stable over time, repeated measures ANOVAs were examined.

Research Question 3: Do individual difference factors alter the relation over time between CN and facets of well-being?

Research Question 3A: Does age predict the changes in any of the above models? Age was proposed as a predictor variable to determine if age predicts change or stability of the above constructs.

Research Question 3B: Does gender predict the changes in any of the above models? Gender was proposed as a predictor variable to determine if gender predicts change or stability of the above constructs.

Research Question 3C: Does participant location predict the changes in any of the above models? Location was proposed as a predictor variable to determine if location predicts change or stability of the above constructs.

Research Question 4: Waves 1, 2, 3 (2015, 2016, 2017). Examining the reciprocal association between CN and well-being over time. Based on the principles of broaden-and-build (Fredrickson, 2004), it was proposed that CN leads to greater happiness, which in turn exerts a reciprocal influence. The following research questions were based on the idea that CN and both emotional and subjective physical well-being predict each other over time. Most research assessing the relation between CN and well-being has been unidirectional with CN predicting well-being. Because of the lack of research assessing the bidirectional association, research questions were examined for the broaden-and-build theory.

Research Question 4A: Through correlational research, it has been shown that spending time in the natural world is associated with an increase in positive affect (Capaldi, Passmore, Nisbet, Zelenski, & Dopko, 2015). A cross-lagged path analysis was used to examine if CN and positive affect predict each other over time. Covariates were then added to each path model to evaluate if age, gender, and location were associated with CN and PA.

Research Question 4B: Through experimental research, it has been shown that walking in the natural environment decreases negative affect (Mayer, Frantz, Bruehlman-Senecal, & Dolliver, 2009). A cross-lagged path analysis was used to examine if CN and negative affect predict each other over time. Covariates were then added to each path model to evaluate if age, gender, and location were associated with CN and NA.

Research Question 4C: Through correlational research, it has been shown that spending time in the natural world is associated with an increase in life satisfaction (Capaldi et al., 2015). A cross-lagged path analysis was used to examine if CN and life satisfaction predict each other over time. Covariates were then added to each path model to evaluate if age, gender, and location were associated with CN and life satisfaction.

Research Question 4D: Multiple studies have shown that CN is associated with a reduction in negative subjective physical health and an increase in positive subjective physical health (Hansmann, Hug, & Seeland, 2007; Korpela & Ylen, 2007). A cross-lagged path analysis was used to examine if CN and subjective health predict each other over time. Covariates were then added to each path model to evaluate if age, gender, and location were associated with CN and subjective health.

Method

The Daily Affect and Behavior Study (DABS) includes three completed waves of data. Waves 1, 2, and 3 include an investigation of connectedness to nature, subjective health, spirituality, religion, and emotional well-being in adulthood. Cross-sectional analyses are for one wave of data, and longitudinal analyses consisted of three waves of data collection: DABS-I (2015), DABS-II (2016), and DABS-III (2017). The study made use of experience sampling data and online surveys. DABS-I had a baseline survey, experience sampling method (ESM; Larson & Csikszentmihalyi, 1983) for eight days, three times a day, and a follow-up survey. DABS-II and DABS-III consisted of 3 days of surveys. See Figure 1 for a flow chart of data collection and participants.

Participants and Recruitment Process

Preliminary analyses were first conducted on participant's data to check for missingness (see below), as well as to determine if there were any outliers. After further examination, three participants were excluded from further analyses because their data were determined to be outliers. Outliers were determined through both scatterplot examination and via Mahalanobis distance. Mahalanobis distance is used to assess whether a given point is a multivariate outlier from the other observations in a data set, separately from whether the point is a univariate or bivariate outlier. As such, Mahalanobis distance is calculated as a chi-squared with the degrees of freedom equaling the number of predictors, with any value less than an alpha of .001 being interpreted as an outlier (Mahalanobis, 1936). Three participants were removed from further analyses because they were univariate, bivariate, and multivariate outliers.

DABS-I. Participants were recruited through online advertising. All surveys were completed online between the months of July and December of 2015. DABS-I was a baseline measure, eight days of ESM, and a follow-up survey. For the ESM, each participant completed three surveys (one in the morning, one in the afternoon, and one in the evening) for eight days. Although 280 adults completed the baseline survey, only a subset of 152 adults completed the 8-day ESM portion of the study, with subsequent samples drawn from this pool. The DABS-I sample had an average age of 37.55 years (SD = 15.64; Range 18 -89), and 72.8% of the participants were female. All measures used for this study were collected at baseline.

DABS-II. All of the 152 participants who completed the full baseline, the eight-day daily diary, and the follow-up measures at DABS-I were invited to complete DABS-II. All surveys were completed online one year after DABS-I, between July and December of 2016. A one-year follow-up (DABS-II) netted 88 participants with an average age of 39.55 years (SD = 15.22; Range 18 - 76), 76.1% of whom were female. DABS-II was three days of surveys during the same week, with each participant taking one survey on a Tuesday, one on Thursday, and one on Saturday. All measures used for this study were collected on the first day of collection, Tuesday.

DABS-III. All of the 152 participants who completed DABS-I, even if they did not participate in DABS-II, were invited to participate in DABS-III. All surveys were completed online two years after DABS-I, in October of 2017. A two-year follow-up after DABS-I, DABS-III consisted of 77 participants with an average age of 40.29 years (SD = 14.70; Range 20 -77), and 76.6% of the participants were female. With 60 participants completing all three waves of data. DABS-III was three days of surveys during the same week, so each participant took one survey on a Tuesday, one on Thursday, and one on Saturday. All measures used for this study were collected on the first day of collection, Tuesday.

Measures

Demographics. Demographic information was collected at each wave of data collection for each participant. Age, gender, race, and location were queried. For full demographics, see Table 1. See Appendix A for all measures used in the study.

Location. A participant's location was determined by their latitude and longitude at baseline (DABS-I), Day 1 of DABS-II, and Day 1 of DABS-III. Based on how the Census Bureau divides the United States by region, each participant was divided into the region they completed the survey: Midwest, North East, West, and South. See Figure 2 for the US Census map that was examined to determine the region of each participant. At baseline (DABS-I) there were 4.8% of participants from the West, 33.8% from the Midwest, 11.0% from the Northeast, and 50.3% from the South. At DABS-II there were 0% of participants from the West, 27.3% from the Midwest, 13.6% from the Northeast, and 59.1% from the South. From DABS-I to DABS-II, 19.5% of the participants changed regions. At DABS-III there were 1.3% of participants from the West, 29.9% from the Midwest, 9.1% from the Northeast, and 59.7% from the South. From DABS-II to DABS-III, 17.5% of the participants changed regions. See Figure 3 for the location of participants at DABS-I, Figure 4 for the location of participants at DABS-II, and Figure 5 for the location of participants at DABS-III.

Connectedness to Nature. Mayer and Frantz's (2004) trait Connectedness to Nature Scale (CNS) was included in DABS-I, DABS-II, and DABS-III as an index of CN. The scale includes 14 items, each scored on a 5-point Likert-type scale, with 1 = strongly disagree to 5 = strongly agree. Sample items include, “I often feel a sense of oneness with the natural world around me” and “My personal welfare is independent of the welfare of the natural world.” Negative items were reverse-coded, such that higher scores represent higher levels of CN. In the current study, this scale had good reliability with alphas of .88 - .89. This scale also shows good test-retest reliability with an alpha of .82 (Mayer & Frantz, 2004). See Table 2 for means, standard deviations, and alphas for all waves of CNS. At DABS-I, M = 48.80, SD = 9.74, and α = .89. At DABS-II, M = 47.64, SD = 10.01, and α = .88, and at DABS-III, M = 50.05, SD = 9.73, and α = .89. Although not included as a central goal of the current study, a confirmatory factor analysis was conducted on the Connectedness to Nature scale to verify the number of factors. Even though three factors emerged in the factor analysis most items loaded high on only one factor, therefore CNS was continued to be used as one scale. See Appendix B for a confirmatory factor analysis on the CNS scale. Although not a question of the current study, the relations among CNS and related constructs were undertaken. Thus, see Appendix C for an examination of the relation between CNS, spirituality, and awe.

Emotional Well-Being; Life Satisfaction: The Satisfaction with Life Scale (SWLS; Diener et al., 1985) consists of 5 items, rated on a 7-point Likert-type scale, with 1 = strongly disagree to 7 = strongly agree. A higher score on the SWLS represents greater life satisfaction. Sample items include, “In most ways my life is close to my ideal” and “I am satisfied with life.” SWLS has good test-retest coefficients of .82 and an alpha of .87. Stability over 6-months for both factor loadings and scores has been reported (Wu, Chen, & Tsai, 2009). The SWLS was included in DABS-I, DABS-II, and DABS-III. As shown in Table 2, at DABS-I, M = 23.21, SD

= 6.38, and α = .84. At DABS-II, *M* = 24.60, SD = 6.75, and α = .88, and at DABS-III, *M* = 24.71, SD = 6.54, and α = .89.

Emotional Well-Being; Positive and Negative Affect. The 10-item Philadelphia Geriatric Center Positive (PA) and Negative (NA) Affect Scales were used (Lawton, Kleban, Dean, Rajagopal, & Parmelee, 1992). The five positive emotions consisted of: happy, interested, energetic, content, and warm-hearted and showed good reliability in the current study, with alphas of .74 - .82. The five negative emotions consisted of: annoyed, worried, irritated, and depressed and showed good reliability in the current study, with alphas of .70 -.82. Participants reported on how often they felt each way over the past week. Each item was rated on a 5-point Likert scale, with 1 = never to 5 = very frequently. The PA and NA scales were included in DABS-I, DABS-II, and DABS-III. As shown in Table 2, PA at DABS-I, *M* = 18.10, SD = 2.93, and α = .74. PA at DABS-II, *M* = 17.51, SD = 3.60, and α = .82, and PA at DABS-III, *M* = 17.82, SD = 3.19, and α = .79. NA at DABS-I, *M* = 13.87, SD = 3.04, and α = .70. NA at DABS-II, *M* = 11.82, SD = 3.88, and α = .82, and NA at DABS-III, *M* = 12.04, SD = 3.62, and α = .82.

Subjective physical well-being. The 12-item Short-Form health survey (SF12; Ware, Kosinski, & Keller, 1996) is the standard uses to assess subjective health. The SF12 is the short form of the 36-item health survey (SF-36) and has shown consistent relation to the original SF-36 and good longitudinal stability (Schofield & Mishra, 1998). The SF12 includes 12 items, using multiple ratings to assess a person’s current health. A higher score on the SF12 represents greater subjective physical well-being. The SF12 consists of questions, “In general, would you say your health is” rated on a 5-point Likert scale with 1= excellent to 5= poor, and “During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives, etc)?” rated on a 5-point scale with 1 = all of the time to 5 = none of the time. The SF12 was included in DABS-I, DABS-II, and DABS-III. Provided are the means, standard deviations, and alphas after data transformation. At DABS-I, M = 7.05, SD = .76, and α = .73. At DABS-II, M = 7.01, SD = .75, and α = .73, and at DABS-III, M = 6.98, SD = .69, and α = .69. All waves of subjective physical well-being (SF12) were square root transformed due to problems with a negative skew. To determine if the skew is too high and needs to be transformed, the ratio of the skew divided by the standard deviation was examined. Any ratio of the skew divided by the standard deviation that was over 3.2 or under -3.2 was transformed (Howell, 2009). Although only two waves of the SF12 were over the criterion for skew transformation, all waves were transformed to keep the scales consistent. For the SF12, the ratio for DABS-I was -5.08, for DABS-II the ratio was -3.01, and for DABS-III the ratio was -3.70. See Table 2 for means, standard deviations, and alphas for all waves of the SF12.

Preliminary Analyses

Missingness

Attrition, or dropout, is usually seen through subsequent data collection in longitudinal studies but can also happen when subjects miss answering measures at one wave but return in subsequent waves (Twisk & de Vente, 2002). Completion rates for individual items were high for each wave of data collection; because missingness on scales for individuals was low, 28 individual scores were mean imputed from the item responses they provided for that wave. Of the 152 participants who completed DABS-I, 64 of them did not complete DABS-II, and 75 of them did not complete DABS-III. Also, 14 of the participants did not complete DABS-II but participated in DABS-III.

Attrition analyses were conducted using the 152 participants who completed DABS-I. Analyses compared those who only completed DABS-I surveys versus those who participated in multiple waves of assessment. As shown in Table 3, no significant differences were observed between those who only completed DABS-I and those who also completed at least one subsequent wave for CNS (t (150) = 1.15, p = .25), SWLS (t (149) = -.96, p = .34), PA (t (149) = .71, p = .48), NA (t (149) = .83, p = .41), and SF12 (t (150) = -.41, p = .69).

Results

Hypothesis 1: CN would be positively associated with well-being.

Correlations between CNS and well-being constructs. Pearson and Spearman correlations were used to examine Hypothesis 1, whether and to what extent CNS related to other individual difference variables of well-being. For a quick view of the results, see Table D1 in Appendix D for a summary of hypotheses/research questions, analyses conducted, results, and interpretations. As shown in Table 4, at DABS-I, CNS and PA were significantly positively correlated, $r(151) = .31$, $p < .01$. Also, at DABS-I CNS was not significantly correlated with NA ($r(151) = .00$, $p = .98$), SWLS ($r(151) = .07$, $p = .42$), nor SF12 ($r(152) = .02$, $p = .83$). Similarly, at DABS-II, CNS and PA retained their significant association, $r(87) = .28$, $p < .05$. CNS at DABS-II was, also, significantly positively associated with SWLS, $r(87) = .21$, $p < .05$. Although, at DABS-II, CNS was not significantly associated with NA ($r(87) = -.18$, $p = .10$), nor SF12 ($r(87) = -.02$, $p = .89$). Lastly, the pair of CNS and PA retained significant association at DABS-III, $r(87) = .28$, $p < .05$. At DABS-III, CNS was not significantly associated with NA ($r(75) = -.04$, $p = .72$), SWLS ($r(75) = .18$, $p = .12$), nor SF12 ($r(75) = .18$, $p = .12$).

Research Question 1: **What is the strength and magnitude of the association between CN and a variety of individual difference factors?**

Correlations between CNS and age, gender, and location. To examine Research Question 1, whether and to what extent age, gender, and location related to CNS, Pearson and Spearman coefficients were examined. See Table 4 for all correlations with age, gender and location. As shown in Table 4, age was significantly positively associated with CNS at DABS-I, $r(151) = .16$, $p < .05$. Age was not significantly associated with CNS at DABS-II ($r(86) = .07$, $p = .50$), nor DABS-III ($r(75) = .17$, $p = .15$). There were no significant correlations between gender (0 = female, 1 = male) and CNS at DABS-I ($r(151) = -.02$, $p = .78$), DABS-II ($r(87) = -.06$, $p = .61$), or at DABS-III ($r(75) = -.04$, $p = .73$). Because of insufficient cell sizes for West and Northeast, only the participants from the Midwest and South were compared. Similarly, Location, 0 = Midwest and 1 = South, was not significantly associated with CNS at DABS-I ($r(122) = -.14$, $p = .13$), or DABS-II ($r(75) = .03$, $p = .81$). Location was significantly negatively associated with CNS at DABS-III, $r(67) = -.26$, $p = .04$. See Appendix E for the correlations with age, gender, and location and how they related to well-being factors.

Analyses of Variance for CNS and age, gender, and location. To examine Research Question 1, whether and to what extent age, gender, and location related to CNS, mean differences were examined using 1-way Analysis of Variance (ANOVAs). See Appendix F for the ANOVAs with age, gender, and location and how they related to well-being factors.

Age. ANOVAs were used to examine age group differences in CNS. Participants were categorized as younger adults (Range 18-29, N = 62), middle-aged adults (Range 30-55, N = 66) and late middle-aged to older adults (Range 56- 89, N = 24). There were significant differences in CNS by a person’s age, $F(2, 148) = 3.62$, $p = .03$. Levene’s test for homogeneity of variance indicated equal variance across groups (*F* = .51, *p* = .60), so no adjustments were considered. With equal variances, post hoc tests can be used to determine significant pairwise differences. For these data, Tukey's honest significant difference post hoc tests were used to examine pairwise differences (Tukey, 1949). Tukey post-hoc tests showed that the late middle-aged to older adults (*M* = 53.25, SD = 10.01) reported significantly higher CNS than younger adults (*M* = 47.05, SD = 10.27). At DABS-II, no mean differences emerged in CNS as a function of age, *F* (2, 83) = .53, *p* = .59. Lastly, at DABS-III, no mean age group differences in CNS were detected, *F* (2, 72) = .69, *p* = .50.

Gender. ANOVAs were conducted to examine gender group differences in CNS. At DABS-I, Levene's test for homogeneity of variance indicted equal variance across groups (*F* = 1.37, *p* = .24). DABS-I, no differences emerged in CNS as a function of gender, *F* (1, 149) = .00, *p* = .99. For DABS-II, no gender group differences in CNS were detected, *F* (1, 85) = .02, *p* = .90. Lastly, for DABS-III, no difference emerged in CNS as a function of gender, *F* (1, 73) = .00, *p* = .96.

Location. Lastly, because of insufficient cell sizes for West and Northeast, only the participants from the Midwest and South were compared. ANOVAs were used to examine location group differences in CNS. At DABS-I, Levene's test of homogeneity of variance indicated equal variance across groups (*F* = 1.46, *p* = .23). At DABS-I, no location differences in CNS were detected, *F* (1, 120) = 1.71, *p* = .19. At DABS-II, no differences emerged in CNS as a function of location, *F* (1, 73) = .55, *p* = .46. Lastly, for DABS-III, no location differences in CNS were detected, *F* (1, 65) = 2.82, *p* = .10.

Moderators of the CN to Well-being Association

Cross-sectional moderation analyses were conducted to examine how age, gender, and location may influence the CNS to well-being relation. Moderation analyses were conducted using data from DABS-I. DABS-I data were used for the current analyses because they provide the best statistical power. In order to determine the statistical power for the current analyses, a formal power analysis was conducted. A formal power analysis, implemented in G*Power (Erdfelder, Faul & Bechner, 1996), suggested that a n = 151 of would be sufficient to detect a medium-sized effect (f^2 =.25) in a 3-variable regression equation at (power =.95, $p < .05$). For a quick view of the results, see Table D2 in Appendix D for a summary of hypotheses/research questions, analyses conducted, results, and interpretations.

Age. In the analysis examining the main and interaction effects of age and CNS on SWLS, the model was significant, $F(3, 146) = 8.48$, $p < .05$, $R^2 = .05$. CNS ($b = .06$, $p = .24$) did not uniquely contributed to the variance of SWLS. Age ($b = -.09$, $p = .01$) uniquely contributed to the variance accounted for on SWLS. The interaction of CNS and age ($b = -.003$, $p = .46$), did not uniquely contributed to the variance.

In the analysis examining the main and interaction effects of age and CNS on PA, the model was significant, $F(3, 146) = 8.48$, $p < .05$, $R^2 = .15$. Both, CNS ($b = .10$, $p = .00$), and age ($b = -.04$, $p = .00$), uniquely contributed to the variance accounted for on PA. Although, the interaction of CNS and age ($b = .0004$, $p = .77$), did not uniquely contribute to the variance.

In the analysis examining the main and interaction effects of age and CNS on NA, the model was not significant, $F(3, 146) = 1.36$, $p = .26$, $R^2 = .03$. Betas for each tested main effect were small, CN ($b = .003$, $p = .91$) and age ($b = .004$, $p = .81$). The interaction term ($b = .003$, $p = .052$) was also small and failed to uniquely account for variance in NA.

In the analysis examining the main and interaction effects of age and CNS on SF12, the model was significant, $F(3, 147) = 9.74$, $p < .05$, $R^2 = .17$. CNS ($b = .007$, $p = .27$) did not uniquely contribute to the variance accounted for on SF12. Age ($b = -.01$, $p = .00$) uniquely contributed to the variance accounted for on SF12, but the interaction of CNS and age ($b = .00$, $p = .99$), did not uniquely contributed to the variance.

Gender. In the analysis examining the main and interaction effects of gender and CNS on PA, the model was significant, $F(3, 146) = 5.66$, $p < .05$, $R^2 = .10$. CNS ($b = .09$, $p = .00$) uniquely contributed to the variance accounted for on PA. Neither gender ($b = -.65$, $p = .20$), nor the interaction of CNS and gender ($b = .007$, $p = .90$), uniquely contributed to the variance.

In the analysis examining the main and interaction effects of gender and CNS on NA, the model failed to reach significance, $F(3, 146) = .38$, $p = .77$, $R^2 = .01$. Betas for each tested main effect were small, CN ($b = .006$, $p = .81$) and gender ($b = .06$, $p = .92$). The interaction term was also small and failed to uniquely account for variance in NA ($b = .07$, $p = .29$).

In the analysis examining the main and interaction effects of gender and CNS on SWLS, the model failed to reach significance, $F(3, 146) = .25$, $p = .86$, $R^2 = .01$. Betas for each tested main effect were small, CN ($b = .04$, $p = .50$) and gender ($b = -.02$, $p = .99$). The interaction term was also small and failed to uniquely account for variance in SWL ($b = -.05$, $p = .68$).

In the analysis examining the main and interaction effects of gender and CNS on SF12, the model failed to reach significance, $F(3, 147) = .24$, $p = .87$, $R^2 = .00$. Betas for each tested main effect were small, CN ($b = .001$, $p = .84$) and gender ($b = -.12$, $p = .41$). The interaction term ($b = .001$, $p = .96$) was also small and failed to uniquely account for variance in SF12.

Location. In the analysis examining the main and interaction effects of location and CNS on SWLS, the model was significant, $F(3, 117) = 2.74$, $p < .05$, $R^2 = .07$. CNS ($b = .05$, $p =$

.40), did not uniquely contribute to the variance accounted for on SWLS. Location (*b* = 2.96, *p* = .01) uniquely contributed to the variance accounted for on SWLS, but the interaction of CNS and location (*b* = -.11, *p* = .34), did not uniquely contributed to the variance.

In the analysis examining the main and interaction effects of location and CNS on PA, the model was significant, $F(3, 117) = 8.95$, $p < .05$, $R^2 = .19$. Both, CNS (*b* = .12, *p* = .00), and location (*b* = 1.45, *p* = .00) uniquely contributed to the variance accounted for on PA. The interaction of CNS and location (*b* = -.04, *p* = .41) did not uniquely contribute to the variance.

In the analysis examining the main and interaction effects of location and CNS on NA, the model was significant, $F(3, 117) = 2.79$, $p < .05$, $R^2 = .07$. CNS (*b* = -.001, *p* = .99) did not uniquely contribute to the variance accounted for on NA. Both, location (*b* = -1.05, *p* = .04), and the interaction of CNS and location (*b* = .11, *p* = .04), uniquely contributed to the variance account for on NA. See Figure 6 for a graph of the interaction of CNS and location on NA.

In the analysis examining the main and interaction effects of location and CNS on SF12, the model failed to reach significance, $F(3, 118) = .16$, $p = .93$, $R^2 = .00$. Betas for each tested main effect were small, CN (*b* = .005, *p* = .52) and location (*b* = .04, *p* = .78). The interaction term (*b* = .002, *p* = .89) was also small and failed to uniquely account for variance in SF12.

Research Question 2: Examining stability or change of CN over time

Multiple analyses were conducted to determine if CNS was stable over time. Although no hypotheses or research questions were proposed, given that constructs related to CNS are stable over time (Kaiser et al., 2014; Nisbet & Zielenski, 2013), it was reasonable to anticipate that CNS would be stable in the current study. For a quick view of the results, see Table D3 in Appendix D for a summary of hypotheses/research questions, analyses conducted, results, and interpretations. By examining CNS through a repeated measures ANOVA, using time as a factor, it was found that there were no significant mean differences between DABS-I (M = 49.69, SD = 9.82), DABS-II (M = 49.30, SD = 10.08), or DABS-III (M = 50.11, SD = 10.25), F (1, 60) = .45, p = .51.

To further examine the stability or change of CNS over time, a Fisher's r-to-Z transformation was conducted. Using a Fisher's r-to-Z transformation, the magnitude of the correlations obtained were examined to determine whether there is stability or change in the magnitude of associations over the three waves of data collection. The Fisher's Z transformation is a way to transform a Pearson's r to a normal distribution and then compare the standardized scores to see if they are significantly different from each other (Kenny, 1987).

To determine stability or change of CNS, the correlations between DABS-I and DABS-II were compared to the correlations of DABS-I and DABS-II. To further establish stability or change, correlations between DABS-I and DABS-II were compared to correlations of DABS-II and DABS-III. Lastly, correlations between DABS-I and DABS-III were compared to DABS-II and DABS-III. Stability in CNS was observed over time. Stability in r was evident from DABS-I/DABS-II (r = .78) and DABS-I/DABS-III (r = .85; z = -1.31, p = .19). Stability was also detected between DABS-I/DABS-II and DABS-II/DABS-III (r = .85; z = -1.23, p = .22). Lastly, stability was observed between DABS-I/DABS-III and DABS-II/DABS-III (z = 0.00, p = 1.00).

Research Question 2A, 2B, 2C, and 2D: Assessing how CN and well-being change or stay stable over time, using Fisher r-to-Z transformation. Through correlations, there is suggestive evidence that CN relates to well-being. What is not well understood is how they relate over time. With the lack of previous longitudinal research, how the stability of CNS is related to well-being and health could not be examined. In the current study, having established the stability of CNS over time, multiple analyses were investigated to assess the relation between CNS and well-being. The magnitude of the correlations were examined using a Fisher's r-to-Z transformation to determine whether there is stability or change in the magnitude of associations. For a quick view of the results, see Table D4 in Appendix D for a summary of hypotheses/research questions, analyses conducted, results, and interpretations.

Stability over time in the CNS to SWLS association was observed. Stability in r (CNS, SWLS) was observed between DABS-I (r = .07) and DABS-II (r = .21; z = -1.05, p = .29). Stability was detected between DABS-II and DABS-III (r = .18; z = .19, p = .85). Lastly, stability was observed between DABS-I and DABS-III (z = -.78, p = .44).

Stability in the CNS to PA association was observed over time. Stability in r (CNS, PA) was observed between DABS-I (r = .31) and DABS-II (r = .28; z = .24, p = .81). Stability was also observed between DABS-II and DABS-III (r = .28; z = .0, p = 1.00). Lastly, stability was detected between DABS-I and DABS-III (z = .23, p = .82).

Stability over time in the CNS to NA association was observed. Stability in r (CNS, NA) was detected between DABS-I (r = .00) and DABS-II (r = -.18; z = 1.33, p = .18). Stability was observed between DABS-II and DABS-III (r = -.04; z = -.88, p = .38). Lastly, stability was observed between DABS-I and DABS-III (z = .28, p = .78).

Lastly, stability in the CNS to SF12 association was observed over time. Stability in r (SN, SF12) was observed between DABS-I (r = .02) and DABS-II (r = -.02; z = .29, p = .77). Stability was observed between DABS-II and DABS-III (r = .18; z = -1.26, p = .21). Lastly, stability was detected between DABS-I and DABS-III (z = -1.13, p = .26).

Research Question 2A, 2B, 2C, and 2D: Multivariate tests of stability or change. Also, multivariate growth curve models were proposed to determine longitudinal change or stability over time between two variables. The use of growth curve models allows for multiple waves of data to be assessed at one time. Growth curves allow for the determination of intraindividual change, and the examination of interindividual differences in change (Little, 2013). Multilevel growth models estimate both a slope and an intercept. Using a multilevel growth model, the association between the intercepts, slopes, intercept-slope can be determined. For a quick view of the results, see Table D3 in Appendix D for a summary of hypotheses/research questions, analyses conducted, results, and interpretations.

Initial assessment of latent growth models for individual constructs revealed negative variances for CNS. The following multiple strategies were employed to probe and correct the negative variances including: data were reexamined for coding errors, data were square root transformed (Kolenikov & Bollen, 2012), only participants who completed all waves of data were assessed (Okada, 2017), and data were examined for ceiling and floor effects (Kolenikov & Bollen, 2012). After each correction, the negative variance persisted. Thus, latent growth models could not be implemented with CNS and the well-being constructs. Instead, change was assessed via repeated measures ANOVAs. See Appendix G for all corrections tested to alleviate negative variance. See Appendix H for SWLS and SF12, the two constructs that didn’t obtain a negative variance.

Research Question 2A, 2B, 2C, and 2D: Multivariate tests of stability or change assessing how CN and well-being change or stay stable over time, using repeated measures ANOVA. Although assessments of change using latent growth curve models were not feasible, repeated measures ANOVAs with CNS and well-being constructs were conducted. Repeated measures analyses are used to measure main effects within participants, but can also assess the interaction between factors (Cole & Grizzle, 1966). In order to determine the statistical power for the repeated measures ANOVA, a formal power analysis was conducted. A power analysis, implemented in G*Power (Erdfelder, Faul & Bechner, 1996), suggested that an n = 57 of would be sufficient to detect a medium-sized effect (f^2 =.25) in a 3-group (time) with 2-measures repeated measures ANOVA equation (power =.95, p < .05). For a quick view of the results, see Table D4 in Appendix D for a summary of hypotheses/research questions, analyses conducted, results, and interpretations.

A repeated measures ANOVA test was conducted to test whether there were significant mean differences between waves of data on CNS and SWLS. The stability in the main effects of CNS (F (1,60) = .45, p = .51) and SWLS (F (1, 60) = 1.95, p = .17) were evident. Stability in the relation between CNS and SWLS was observed, F (4, 240) = 1.14, p = .34.

In the repeated measures ANOVA examining the differences between waves of data for CNS and PA, univariate tests show the stability of CNS and PA (F (1, 60) = .25, p = .62. Also, stability in the relation of CNS and PA was evident, F (4, 240) = .58, p = .68.

A repeated measures ANOVA test was also conducted to test whether there were significant mean differences between waves of data for CNS and NA. Stability of the main effect of CNS was observed, but there are significant changes in NA over time, F (1, 60) = 11.03, p = .00. The stability of the relation between CNS and NA was not evident, F (4, 240) = 5.79, p = .00.

Lastly, In the repeated measures ANOVA examining the differences between waves of data for CNS and SF12, stability in the main effects of CNS and SF12, F (1, 60) = 1.32, p = .27, were observed. Also, stability in the relation of CNS and SF12 were evident, F (4, 240) = 1.08, p = .37.

Research Question 3: Do individual difference factors alter the relation between CN and facets of well-being?

As above, the assessments of change using latent growth curve models with predictors were not appropriate, therefore repeated measures MANOVAs were conducted. In the repeated measures MANOVA, CNS and the well-being constructs were used as within-subject variables and age, gender, and location were used as between-subject variables. Predictor variables were added to ascertain if age, gender, and location predict the stability of CNS and well-being (or change of NA). For a quick view of the results, see Tables D5 and D6 in Appendix D for a summary of hypotheses/research questions, analyses conducted, results, and interpretations.

A repeated measures MANOVA test was conducted to test how age, gender, and location effect CNS and well-being. The results show that age, gender, and location do not uniquely contribute to the variance accounted for on CNS and SWLS (F (4, 160) = .29, p = .89), CNS and PA (F (4, 160) = .47, p = .76), CNS and NA (F (4, 160) = .91, p = .46), nor CNS and SF12 (F (4, 160) = 1.36, p = .25).

Research Question 4: Examining the reciprocal association between CN and well-being over time.

The current study has exhibited the stability of CNS and its relation to well-being over time. Examining how these constructs might be predictive of each other is the next step in understanding their relation. To examine time precedence and the associations needed to establish causality (Kenny, 1979), cross-lagged panel models were tested. Cross-lagged models allow the variables at earlier time points to be controlled. Although it has become standard to employ fit indices in addition to the chi-square, one does so when large sample sizes would render the chi-square less useful (Burant, 2016; Kenny, Korchmaros & Bolger, 2003). However, the sample available does not require these additional indices. For a quick view of the results, see Tables D7 and D8 in Appendix D for a summary of hypotheses/research questions, analyses conducted, results, and interpretations.

RQ4A: In the cross-lagged path analysis examining the association between CNS and PA, the model does not show good fit, $\chi^2(6, N = 152) = 50.47$, $p = .00$, and is indicative of the fact that there is stability within constructs across time, and that there are no reciprocal effects. Regression weights showed that CNS at DABS-I predicted CNS at DABS-II ($\beta = .79$, $p < .001$), and that CNS at DABS-II significantly predicted CNS at DABS-III ($\beta = .84$, $p < .001$). Examination of regression weights also showed that PA at DABS-I significantly predicted PA at DABS-II ($\beta = .42$, $p < .001$), and PA at DABS-II significantly predicted PA at DABS-III ($\beta = .60$, $p < .001$). No cross-lagged paths emerged as significant. See Table 5 and Figure 7 for all standardized regression weights.

Age. Predictor variables were then examined to determine if age, location, or gender were associated with CNS and PA. See Appendix I for full analyses with all three covariates in one model. In the cross-lagged path analysis examining the association between CNS and PA with age as a covariate, the model had a poor fit, $\chi^2(11, N = 152) = 70.56$, $p = .00$, and is indicative of stability within constructs across time. Age was significantly associated with CNS ($\beta = .16$, $p = .04$), and significantly associated with PA ($\beta = -.18$, $p = .02$). See Table 5 and Figure 8 for full model with all regression weights.

Gender. In the cross-lagged path analysis examining the association between CNS and PA with gender as a covariate (0 = female, 1 = male), the model had poor fit, $\chi^2(11, N = 152) = 67.56$, $p = .00$, and is indicative of stability within constructs across time. Gender was not significantly associated with CNS (β = .00, p = 1.00), nor was it significantly associated with PA (β = -.10, p = .21). See Table 5 and Figure 9 for full model with all regression weights.

Location. In the cross-lagged path analysis examining the association between CNS and PA with location as a covariate (0 = Midwest, 1 = South), the model had poor fit and is indicative of stability within constructs across time, $\chi^2(11, N = 152) = 70.61$. Location was not significantly associated with CNS (β = -.11, p = .21), but was significantly associated with PA (β = .19, p = .03). See Table 5 and Figure 10 for full model with all regression weights.

RQ4B: In the cross-lagged path analysis examining the association between CNS and NA, the model does not show good fit and is indicative of the fact that there is stability within constructs across time, and that there are no reciprocal effects, $\chi^2(6, N = 152) = 33.68$, p = .00. Examination of regression weights showed that NA at DABS-I significantly predicted NA at DABS-II (β = .48, p <.001), and NA at DABS-II significantly predicted NA at DABS-III (β = .58, p <.001). Two cross-lagged paths emerged as significant with NA at DABS-I significantly predicted CNS at DABS-II (β = -.13, p = .04) and NA at DABS-II significantly predicted CNS at DABS-III (β = .15, p = .02). Though, no other cross-lagged paths emerged as significant, see Table 6 and Figure 11 for all standardized regression weights.

Age. Predictor variables were then examined to determine if age, location, or gender were associated with CNS and NA. See Appendix I for full analyses with all three covariates in one model. In the cross-lagged path analysis examining the association between CNS and NA with age as a covariate, the model had poor fit and is indicative of stability within constructs across time, $\chi^2(11, N = 152) = 37.27$. Age was significantly associated with CNS (β = .16, p = .04), but not significantly associated with NA (β = .04, p = .63). See Table 6 and Figure 12 for full model with all regression weights.

Gender. In the cross-lagged path analysis examining the association between CNS and NA with gender as a covariate (0 = female, 1 = male), the model had poor fit, which indicates stability within constructs across time, $\chi^2(11, N = 152) = 36.36$, $p = .00$. Gender was not significantly associated with CNS ($\beta = .001$, $p = .99$), nor was it significantly associated with NA ($\beta = .01$, $p = .92$). See Table 6 and Figure 13 for full model with all regression weights.

Location. In the cross-lagged path analysis examining the association between CNS and NA with location as a covariate (0 = Midwest, 1 = South), the model had poor fit, which indicates stability within constructs across time, $\chi^2(11, N = 152) = 34.71$, $p = .00$, CMIN/DF = 3.16, CFI = .89, and RMSEA =.12. Location was not significantly associated with CNS ($\beta = -.12$, $p = .18$), but was significantly associated with NA ($\beta = -.20$, $p = .03$). See Table 6 and Figure 14 for full model with all regression weights.

RQ4C: In the cross-lagged path analysis examining the association between CNS and life satisfaction, the model does not show good fit and is indicative of the fact that there is stability within constructs across time, and that there are no reciprocal effects, $\chi^2(6, N = 152) = 40.38$, $p = .00$. Examination of regression weights showed that life satisfaction at DABS-I significantly predicted life satisfaction at DABS-II ($\beta = .71$, $p <.001$), and life satisfaction at DABS-II significantly predicted life satisfaction at DABS-III ($\beta = .78$, $p <.001$). No cross-lagged paths emerged as significant. See Table 7 and Figure 15 for all standardized regression weights.

Age. Predictor variables were then examined to determine if age, location, or gender were associated with CNS and life satisfaction. See Appendix I for full analyses with all three covariates in one model. In the cross-lagged path analysis examining the association between CNS and life satisfaction with age as a covariate, the model had poor fit and is indicative of stability within constructs across time, $\chi^2(11, N = 152) = 45.11$, $p = .00$. Age was significantly associated with CNS (β = .16, p = .04), and also significantly associated with life satisfaction (β = -.20, p = .01). See Table 7 and Figure 16 for full model with all regression weights.

Gender. In the cross-lagged path analysis examining the association between CNS and life satisfaction with gender as a covariate (0 = female, 1 = male), the model had poor fit and is indicative of stability within constructs across time, $\chi^2(11, N = 152) = 41.92$. Gender was not significantly associated with CNS (β = .001, p = .99), nor was it significantly associated with life satisfaction (β = -.001, p = .99). See Table 7 and Figure 17 for full model with all regression weights.

Location. In the cross-lagged path analysis examining the association between CNS and life satisfaction with location as a covariate (0 = Midwest, 1 = South), the model had poor fit which indicates stability within constructs across time, $\chi^2(11, N = 152) = 44.47$, p = .00, CMIN/DF = 4.04, CFI = .89, and RMSEA =.14. Location was not significantly associated with CNS (β = -.11, p = .21), but was significantly associated with life satisfaction (β = .23, p = .01). See Table 7 and Figure 18 for full model with all regression weights.

RQ4D: In the cross-lagged path analysis examining the association between CNS and physical health, the model does not show good fit and is indicative of the fact that there is stability within constructs across time, and that there are no reciprocal effects, $\chi^2(6, N = 152)$ = 44.88, p = .00. Examination of regression weights showed that subjective physical health at DABS-I significantly predicted subjective physical health at DABS-II (β = .67, p <.001), and subjective physical health at DABS-II significantly predicted subjective physical health at DABS-III (β = .82, p <.001). One cross-lagged path analysis emerged as significant. CNS at DABS-II significantly predicted SF12 at DABS-III, β = .16, p = .03. No cross-lagged paths emerged as significant, see Table 8 and Figure 19 for all standardized regression weights.

Age. Predictor variables were then examined to determine if age, location, or gender were associated with CNS and physical health. See Appendix I for full analyses with all three covariates in one model. In the cross-lagged path analysis examining the association between CNS and subjective physical health with age as a covariate, the model had a poor fit, which indicates stability within constructs across time, $\chi^2(11, N = 152) = 58.64$, $p = .00$. Age was significantly associated with CNS ($\beta = .16$, $p = .04$), and significantly associated with subjective physical health ($\beta = -.40$, $p < .001$). See Table 8 and Figure 20 for full model with all regression weights.

Gender. In the cross-lagged path analysis examining the association between CNS and physical health with gender as a covariate (0 = female, 1 = male), the model had a poor fit, which indicates stability within constructs across time, $\chi^2(11, N = 152) = 45.90$, $p = .00$. Gender was not significantly associated with CNS ($\beta = .001$, $p = 1.00$), nor was it significantly associated with subjective physical health ($\beta = -.07$, $p = .41$). See Table 8 and Figure 21 for full model with all regression weights.

Location. In the cross-lagged path analysis examining the association between CNS and physical health with location as a covariate (0 = Midwest, 1 = South), the model had poor fit and is indicative of stability within constructs across time, $\chi^2(11, N = 152) = 47.73$. Location was not significantly associated with CNS ($\beta = -.12$, $p = .18$), nor was it significantly associated with subjective physical health ($\beta = .02$, $p = .80$). See Table 8 and Figure 22 for full model with all regression weights. For a quick view of the results, see Appendix D for a summary of hypotheses/research questions, analyses conducted, results, and interpretations.

Discussion

Connectedness to nature encompasses both a person's emotional connection with the natural world, but also a person's experiential component of belonging to nature (Mayer et al., 2009). A person develops a connection to nature by building a deep emotional connection and by spending time with the natural elements. Previous cross-sectional research has shown that connectedness to nature has been associated with multiple aspects of well-being. A higher CN has been shown to be associated with higher positive affect and greater life satisfaction (Capaldi, Dopko, & Zelenski, 2014). It has also been found that spending time in nature reduces negative affect and reduces the negative physical symptoms that people feel from stress (i.e., headaches, stomach pains, dizziness; Korpela & Ylen, 2007). With so much research showing the cross-sectional benefits of nature, the next logical step was to examine the association of CN and well-being over time as well as identifying potential covariates of the CN and well-being associations. The current study is the first to examine the longitudinal nature of CN and well-being.

The current study addressed five questions: (a) does connectedness to nature stay stable or change over time (b) what is the association of connectedness to nature and well-being cross-sectionally, (c) does the association of connectedness to nature and well-being change or stay stable over time, (d) do connectedness to nature and well-being have a reciprocal association over time, and (e) how do age, gender, and location relate to the associations above.

Understanding the Stability or Change of CN

Understanding the stability or change of CN is the foundational question of the current study. If CN is not stable over time, then it is unlikely to exert consistent effects on any construct of well-being. Also, if CN is not stable, then identifying predictors is unnecessary. Given that other related constructs like attitudes toward nature and attitudes toward the environment are stable (Kaiser et al., 2014; Nisbet & Zielenski, 2013), it was reasonable to anticipate that CN would be stable in the current study. Moreover, given that there have been positive outcomes related to CN (Pryor et al., 2007), it is important to know the predictors of CN.

Although the short-term stability of CN was known, it was unclear whether CN would remain stable or change over a longer period. Because the latent growth analyses to understand the stability and change of CN resulted in negative variance, repeated measures ANOVA and r-to-Z transformations were used to examine stability. Based on both of these analyses, it was found that CN is a stable trait over a 2-year period. These results may support the notions of the ecological self theory. The ecological self theory posits that a person's identity includes a sense of one’s self, but also extends to include all other life-forms (Bragg, 1996). According to ecological self, a person’s identity is tied to their identity with nature, and if a person’s identity is stable, their CN may also be stable.

The preponderance of the evidence from this study shows that CN is stable across time. Correlations show a strong positive association between the waves of CN data. Further, repeated measures ANOVAs show that there were no significant differences between the waves of CN data. Lastly, autoregressive paths in the path analyses show that CN predicts the subsequent CN. Although latent growth curve models were proposed, due to the negative variance for the slope, they could not be used to assess change. These analyses, taken together, show that CN is a stable construct over the 2-years of assessment.

Predictors of Connectedness to Nature

Given that CN is stable over time, it is important to understand what variables might predict CN. Although previous studies have shown that all age groups benefit from CN (Bisceglia, Perlman, Schaack, & Jenkins, 2009; Han, 2008; Mayer et al., 2009), there have been no studies conducted to determine if there are age differences in CN. The current correlational analysis suggests that with a full sample CN varies by age, with older adults having higher CN than younger adults. With the largest sample size and the greatest variation in age, correlations show a small, but positive association with CN and age (r = .16). To further corroborate the above findings, mean differences in CN were found as a function of age in ANOVAs. In DABS-I there were significant differences in CN by age with late middle-aged and older adults having greater CN than younger adults. Variations in CN as a function of age did not continue into the other two waves of data. The current examination found that age is a correlate of CN. Because previous research had all but ignored the association of CN and age, it should be considered as a potential predictor of CN in future research.

Previous research has shown that women participate in more environmentally conscious behaviors (Zelezny, Chua, & Aldrich, 2000) and women experience more physical benefits from spending time in nature (Kim & Mattson, 2002). The current study found no gender differences in CN, similar to the results of Mayer and Frantz (2004) who used the same measure of CN. Although caution is warranted in the current examination, statistics show that the homogeneity of variance was not violated for ANOVAs even with the unequal sample sizes for gender. Future research should try to address gender differences to be able to make more definitive conclusions.

Previous research has also focused on whether and in what way location may be related to CN. People who live in rural areas are more connected and engaged with nature compared to urban participants (Bunting & Cousins, 1985; Hinds & Sparks, 2008). It has also been found that people who spend time in temperate climates have greater well-being compared to those who spend time in tropical climates (Saw et al., 2015). The current study, examining the South and Midwest, found no significant differences in CN as a function of location. A more nuanced examination of location may be warranted as many people contest that the US Census breakdown of regions is too broad (Woodard, 2012).

Cross-sectional Associations

Previous research has shown that greater CN is associated to greater positive affect, greater life satisfaction, better health, and lower negative affect (Herzog & Strevey, 2008; Korpela & Ylen, 2007; Mayer, Frantz, Bruehlman-Senecal, & Dolliver, 2009). Knowing that CN is stable over the 2-year period of this study, the next question that was examined is how does CN relate to well-being, cross-sectionally? Correlational data show that for DABS-I, CN was significantly positively correlated with PA, but not significantly correlated with any of the other well-being variables. For DABS-II, CN was significantly positively correlated with SWLS and PA. Lastly, for DABS-III, CN was significantly positively correlated with PA, but not significantly correlated with any other well-being variables. The broaden-and-build theory may be supported in that PA is the only consistent form of well-being significantly associated with CN, cross-sectionally. Broaden-and-build posits that people broaden their actions and try new experiences when they experience positive emotions (Fredrickson, 2004). Based on this idea, it was found that people who had higher PA also had higher CN. This association may occur because participants may be exploring new experiences in nature and developing a deeper CN. Those deeper connections with nature may then encourage greater PA, or happier people may feel more connected. The interplay between CN and PA helps to support the cyclical experiences of broaden-and-build.

CN was not significantly associated with any other construct of well-being in all three waves. These null findings may contradict some of the previous literature on the effect of CN on life satisfaction (Capaldi, Dopko, & Zelenski, 2014), negative affect, and physical health

(Hansmann, Hug, & Seeland, 2007). Significant associations were not observed between CN, NA, and SWLS in DABS-I or DABS-III. Understanding why CN was not associated with various well-being factors needs to be examined in future research.

Moderators of the CN to Well-being Association

Connectedness to nature and positive affect had a direct association, but CN was not significantly associated with other well-being variables. Because there were no direct associations between CN and some well-being factors, other individual difference variables were examined for main and interaction effects. From examining the interaction effects between CN and age, gender, and location on well-being, only one interaction effect emerged. Although interaction effects were not observed, main effects were present for age and location. Gender did not exert any direct effects on the well-being constructs.

CN only exerted positive direct effects on PA. Age, though, exerted significant negative direct effects on SWLS, PA, and SF12. The direct effect of age means that older adults had lower levels of life satisfaction, positive affect, and subjective physical well-being. These moderation analyses should be approached with caution, and no causation can be inferred because the data are cross-sectional. These analyses are not implying that SWLS, PA, and subjective physical well-being decreases with age, but rather there are differences between younger and middle-aged and older adults at one specific time-point. Although, the results of subjective physical well-being appear to support previous literature with noticeable onsets in middle age (Lachman, 2004). Also, middle-aged and older adults tend to have lower ratings on subjective physical well-being (Kostka & Bogus, 2007). The lower subjective physical well-being may mean that middle-aged and older adults feel like their physical health is not as good as it once was.

By examining the direct effect of location and the interaction of location and CN on well-being, it was found that CN continued to exert direct effects on PA. Location exerted positive main effects on SWLS, PA, and negative direct effects on NA. With location being a dichotomous variable (0 = Midwest, 1 = South) it was found that people in the South had significantly higher SWLS, PA, and lower NA compared to people who lived in the Midwest. Because previous research had examined the association of urban vs. rural participants in their CN and well-being, this study was the first to examine location. For further evaluation of rural vs. urban, see Appendix J. Although 22 states were represented in the data collection, most of the participants were from the Midwest and the South. To get a truer picture of whether location is associated with CN and well-being a more diverse sample would be needed.

Assessing Change Over Time Between CN and Well-being

Given that cross-sectional associations have been found between CN, well-being, and moderators, it then becomes important to understand the association of these constructs over time. As previously described, latent growth curves could not be conducted because of negative variance, but it can be assumed that the estimations of the construct were so stable that most of the participants did not show any change. Instead, Fisher's r-to-Z transformations and repeated measures ANVOAs were utilized to asses change for CN and well-being. For the association between CN and the four aspects of well-being (SWLS, PA, NA, and SF12) it was found that the correlations between waves did not significantly differ. Thus the association between CN and well-being stays stable over time. Repeated measures ANOVAs corroborate the findings of the r-to-Z transformation, in that there were no signficant mean changes within and between the constructs over the three waves of the study. Although these analysis are represented by a small number of participants, by DABS-III (N = 77), power analyses showed that only a sample of 57 was needed to reject the null. Taken together, these results show that the relation of CN and well-being are stable constructs over time. In the current examination, CN and well-being are assumed to be stable constructs, but further evaluation, with a longer time frame, is needed to determine if this association remains.

Examining the reciprocal association between CN and well-being over time

Previous research examining broaden-and-build theory has found an in-the-moment, cyclical, association between positive emotions and broadened actions (Fredrickson, 2004). As people experienced positive emotions (joy, interest, contentment, and love), they would want to broaden their experiences within their environment. The in-the-moment association that was originally posited by broaden-and-build was supported within the current study because correlations between CN and PA had significant positive associations. The current study wanted to extend the findings that support broaden-and-build by trying to determine if these reciprocal associations also happened over time and with other constructs of well-being. By using cross-lagged path analyses, it was found that broaden-and-build does not hold up over time for positive affect. The current study also shows that broaden-and-build may not apply to aspects of well-being, other than positive affect. Path analyses showed that CN predicted CN over time and that all four aspects of well-being predicted well-being over time, but there were no significant cross-lagged paths. With each construct predicting themselves over time. it can be posited that each construct is stable over the 2-year sampling of the current study. This stability also means that CN at time one did not significantly predict well-being at time two and the same was true for CN at time two and well-being at time three. Due to the lack of significant cross-lagged paths, findings from the cross-sectional literature is supported, such that CN and well-being are associated in-the-moment (Capaldi, Dopko, & Zelenski). These results also help to support the notion that broaden-and-build is in-the-moment and not long-term.

When covariates were added to the path analyses, age significantly predicted CN, with a positive association. Meaning that older people reported higher CN. Age was also associated with PA and SWLS such that older adults reported lower PA and SWLS. The declines were also true for subjective physical well-being, with older adults having a worse perception of their physical health. These associations are similar to the results of the ANOVAs, which were previously discussed. Although age is important in the prediction of well-being, other factors may play a more important role (Knepple Carney & Patrick, 2017; Morganti, Nehrke, Hulicka, & Cataldo, 1988; Stahl & Patrick, 2012). These results, though, are promising in trying to understand how age may play a role in a person's CN and needs to be examined in future research.

Because age may not be the only covariate to help to explain CN and well-being, other covariates were also examined. Gender was also examined as a covariate and although previous research has shown gender differences in CN and well-being (Martyn & Brymer, 2016; Mayer & Frantz, 2004; Zelezny, Chua, & Aldrich, 2000), the current examination did not find these results. The lack of differences in CNS as a function of gender may have occurred because the current study used a broader age range than previous studies.

Lastly, previous research has established that people living in rural areas were more connected to nature, compared to those living in urban areas (Bunting & Cousins, 1985; Hinds & Sparks, 2008), but no research has established if living in differing regions of the U.S. has an association with CN and well-being. In the current examination, it was found that a person's location within the U.S. was not associated with CN, but was associated with PA, NA, and

SWLS. It was found that people who live in the South had significantly higher levels of PA and SWLS, and significantly lower NA. These results need to be approached cautiously because 71.05% of the Southern population was from West Virginia and previous research has shown that West Virginia is one of the states to rank lowest in well-being (Rentfrow, Mellander, and Florida, 2009). There are many artifacts that create this disparity. People were mostly tested in November and December, when weather patterns may have a greater impact on well-being, although this was not directly tested. Also, the people who chose to be part of the study may be different than the typical West Virginia population. Location seemed to be an important predictor of well-being in this study and needs to be further examined in future research.

Limitations

One of the main issues in longitudinal studies is attrition (Twisk & de Vente, 2002). The current study had approximately a 50% attrition rate from DABS-I through DABS-III. Attrition is a concern because participants who stay in the study may vary on a key variable compared to those who drop out of the study (Gustavson, von Soest, Karevold, & Røysamb, 2012). Through preliminary assessments, it was determined that in the current study those who only completed one wave of data were not significantly different than those who completed more than one wave of data. Although the participants in the current study did not differ on key variables, they may have differed in other ways that may have an impact on the current examination.

Although DABS covers a 3-year span, it is hard to determine if there is too much time between each collection phase. 1 year between each wave of data collection may affect ratings of CN and well-being. Although impossible for the scope of this study, future research may want to examine daily assessments of CN and well-being to see how they relate in the short-term. It is hard to determine with 1-year gaps how stable CN and well-being are together or if there may be daily ups and downs of the constructs.

Lastly, it is hard to determine the generalizability of the current data because only two regions in the United States were represented. To get a broader understanding of CN and well-being people from all regions of the United States need to be examined. Based on the current study it is hard to determine how well CN in this sample represents typical CN within the United States.

Conclusions and Future Research

The findings from this study support future investigations of the long-term stability of CN. If CN continues to stay stable for a longer period, then it is likely to exert consistent effects on well-being. Also, given that there have been positive outcomes related to CN (Pryor et al., 2007), then identifying other predictors is necessary. Previous studies examining the CN and well-being association have shown equivocal results with the positive effects related to experimental research and interventions (Mayer et al., 2009; Pryor et al., 2007). These previous studies show that CN might have specific or momentary effects. Through the current study, it has been established that CN is a stable trait-like construct that both correlates with and predicts positive well-being.

The current analyses also show that age may be a factor in understanding CN. Previous research has ignored the implications that age may have for CN. The current study emphasizes how future research needs to consider the potential implications age has on CN. Another factor for future research to consider is the time of year. Time of the year may play a role in whether a person feels more or less connected to nature, and this could be assessed by examining people during the different seasons of the year. Thus, future studies should use shorter time frames between assessments to establish if there are seasonal changes in CN. Lastly, location may also be a predictor of CN, but a more diverse sample is needed to understand how location may be associated with CN.

Despite the challenges of recruiting and maintaining a longitudinal sample, this study advances the field in four important ways. First, the evidence shows that CN is related to well-being. Second, the preponderance of the evidence shows stability in CN, over at least a 2-year period. Thus, CN might be an internal resource which can be utilized in interventions. Third, predictors like age, gender, and location play a role in the examination of CN and well-being. Lastly, the current evidence shows support for both broaden-and-build and the ecological self theory in defining the CN and well-being relations.

References

Adler, M. G., & Fagley, N. S. (2005). Appreciation: Individual differences in finding value and meaning as a unique predictor of subjective well being. *Journal of Personality, 73*(1), 79-114.

Bisceglia, R., Perlman, M., Schaack, D., Jenkins, J. (2009). Examining the psychometric properties of the Infant-Toddler Environment Rating Scale-Revised Edition in high-stakes context. *Early Childhood Research Quarterly, 24*, 121-132.

Blair, L. (2011). Ecopsychology and the person-centred approach: Exploring the relationship. *Counselling Psychology Review, 26*(1), 43-52.

Bradburn, N.M. & Caplovitz, D. (1965). *Reports of happiness.* Chicago: Aldine.

Bragg, E.A. (1996). Towards ecological self: Deep ecology meets constructionist self theory. *Journal of Environmental Psychology, 16,* 93-108.

Bunting, T. E., & Cousins, L. R. (1985). Environmental dispositions among school-age children: A preliminary investigation. *Environment and Behavior, 17*, 725–768.

Burant, C.J. (2016). Latent growth curve models: Tracking changes over time. *The International Journal of Aging and Human Development, 82*, 336-350.

Capaldi, C. A., Dopko, R. L., & Zelenski, J. M. (2014). The relationship between nature connectedness and happiness: A meta-analysis. *Frontiers in psychology, 5*, 1-15.

Capaldi, C. A., Passmore, H.-A., Nisbet, E. K., Zelenski, J. M., & Dopko, R. L. (2015). Flourishing in nature: A review of the benefits of connecting with nature and its application as a wellbeing intervention. *International Journal of Wellbeing, 5*(4), 1–16. http://doi.org/10.5502/ijw.v5i4.449

Carstensen, L.L. (1995). Evidence for a life-span theory of socioemotional selectivity. *Current Directions in Psychological Science, 4*, 151-156.

Catalino, L. I., Algoe, S. B., & Fredrickson, B. L. (2014). Prioritizing positivity: An effective approach to pursuing happiness? *Emotion*, *14*, 1155.

Cole, J.W.L., & Grizzle, J.E. (1966). Applications of multivariate analysis of variance to repeated measurements experiments. *Biometrics, 22*, 810-828.

Cowen, A.S. & Keltner, D. (1997). Self-report captures 27 distinct categories of emotion bridged by continuous gradients. *PNAS Proceedings of the National Academy of Science in the United States of America*, *114*(38), E7900-E7909.

Diener, E., & Chan, M. Y. (2011). Happy people live longer: Subjective well-being contributes to health and longevity. *Applied Psychology: Health and Well‐Being*, *3*(1), 1-43.

Diener, E., Emmons, R.A., Larsen, R.J., & Griffin, S. (1985). The satisfaction with life scale. *Journal of Personality assessment, 49*(1), 71-75.

Diener, E., Suh, E. M., Lucas, R. E., & Smith, H. L. (1999). Subjective well-being : Three decades of progress. *Psychological Bulletin*, *125*(2), 276–302. http://dx.doi.org/10.1037/0033-2909.125.2.276

Diessner, R., Solom, R.C., Frost, N.K., Parsons, L., Davidson, J. (2008). Engagement with beauty: Appreciating natural, artistic, and moral beauty. *The Journal of Psychology*, *142*(3), 303-329.

Erdfeld, E., Faul, F., & Buchner, A. (1996). GPOWER: A general power analysis program.

Behavior Research Methods, Instruments, & Computers, 28, 1-11. doi:10.3758/BF03203630

Forgeard, M.J.C., Jayawickreme, E., Kern, M.L., & Seligman, M.E.P. (2011). Doing the right thing: Measuring wellbeing for public policy. *International Journal of Wellbeing* 1(1).

Fredrickson, B. L. (2004). The broaden-and-build theory of positive emotions. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *359*(1449), 1367-1377.

Friedman, H. S., & Kern, M. L. (2014). Personality, well-being, and health. *Annual review of psychology*, *65*, 719-742.

Graf, A. S., & Patrick, J. H. (2016). Self-assessed health into late adulthood: Insights from a lifespan perspective. *The Journal of Gerontopsychology and Geriatric Psychiatry*, *29*(4), 177-187.

Grinde, B., & Patil, G. G. (2009). Biophilia: Does visual contact with nature impact on health and well-being? *International Journal of Environmental Research and Public Health*, *6*, 2332-2343. http://doi.org/10.3390/ijerph6092332

Gustavson, K., von Soest, T., Karevold, E., & Røysamb, E. (2012). Attrition and generalizability in longitudinal studies: Findings from a 15-year population-based study and a Monte Carol simulation study. *BMC Public Health, 12:*918.

Han, K.-T. (2008). Influence of limitedly visible leafy indoor plants on the psychology, behavior, and health of students at a junior high school in Taiwan. *Environment and Behavior*, *41*(5), 658–692. http://doi.org/10.1177/0013916508314476

Hansmann, R., Hug, S. M., & Seeland, K. (2007). Restoration and stress relief through physical activities in forests and parks. *Urban Forestry and Urban Greening*, *6*(4), 213–225. http://doi.org/10.1016/j.ufug.2007.08.004

Herzog, T. R., & Strevey, S. J. (2008). Contact with nature, sense of humor, and psychological well-being. *Environment and Behavior, 40*(6), 747-776. http://dx.doi.org/10.1177/0013916507308524.

Hinds, J., & Sparks, P. (2009). Investigating environmental identity, well-being, and meaning. *Ecopsychology*, *1,* 181-186.

Howell, D.C. (2009). *Statistical methods for psychology.* (7th. Ed.) Belmont, CA: Duxbury Press.

Idler, E. L., & Benyamini, Y. (1997). Self-rated health and mortality: A review of twenty-seven community studies. *Journal of Health and Social Behavior, 38*(1), 21-37.

Jylhä, M. (2009). What is self-rated health and why does it predict mortality? Towards a unified conceptual model. *Social science & medicine*, *69*(3), 307-316.

Kaiser, F.G., Brügger, A., Hartig, T., Bogner, F.X., & Gutscher, H. (2014). Appreciation of nature and appreciation of environmental protection: How stable are these attitudes and which comes first? *Revue européenne de psychologie appliquée, 64,* 269–277.

Kaplan, R., & Kaplan, S. (2011). Well-being, reasonableness, and the natural environment. *Applied Psychology: Health and Well-Being*, *3*(3), 304–321. http://doi.org/10.1111/j.1758-0854.2011.01055.x

Kaplan, S. (1995). The restorative benefits of nature: Toward an integrative framework. *Journal of Environmental Psychology*, *15*(3), 169–182. http://doi.org/10.1016/0272-4944(95)90001-2

Kenny, D. (1979). *Correlation and Causality*. Wiley: New York, NY.

Kenny, D. (1987). *Statistics for the Social and Behavioral Sciences.* Little, Brown and Company: Canada.

Kenny, D.A., Korchmaros, J.D., & Bolger, N. (2003). Lower level mediation in multilevel models. *Psychological Methods, 8,* 115-128.

Kern, M. L., Waters, L. E., Adler, A., & White, M. A. (2015). A multidimensional approach to measuring well-being in students: Application of the PERMA framework. *The Journal of Positive Psychology*, *10*(3), 262-271.

Kim, E., & Mattson, R.H. (2002). Stress recovery effects of viewing red-flowering geraniums. *Journal of Therapeutic Horticulture, 13*, 4-12.

Knepple Carney, A. & Patrick, J.H. (2017). Time for a change: Temporal perspectives and health goals. *Personality and Individual Differences*, *109*, 220-224.

Knepple Carney, A., Turiano, N.A., & Patrick, J.H. (2017). Changes in neighborhood quality related to changes in well-being. *Senior Housing and Care Journal, 25*, 97-111.

Kolenikov, S. & Bollen, K.A. (2012). Testing negative error variance: Is a Heywood case a symptom of misspecification? *Sociological Methods and Research, 4*, 124-167.

Korpela, K. M., & Ylen, M. (2007). Perceived health is associated with visiting natural favorite places in the vicinity. *Health & Place, 13*, 138–151. http://doi.org/10.1016/j.healthplace.2005.11.002

Kostka, T., & Bogus, K. (2007). Independent contribution of overweight/obesity and physical inactivity to lower health-related quality of life in community-dwelling older subjects. *Zeitschrift für Gerontologie und Geriatrie, 40*(1), 43-51.

La Placa, V., McNaught, A., & Knight, A. (2013). Discourse on wellbeing in research and practice. *International Journal of Wellbeing*, *3*(1).

Lachman, M.E. (2004). Development in midlife. *Annual Review of Psychology, 55,* 305-331.

Larson, R. & Csikszentmihalyyi, M. (1983). The experience sampling method. *New Directions for Methodology of Social and Behavioral Science,* 15, 41.56.

Lawton, M.P., Kleban, M.H., Dean, J., Rajagopal, D., & Parmelee, P.A. (1992) The factorial generality of brief positive and negative affect measures. *Journal of Gerontology, Psychology Sciences, 47,* 228-237.

Lawton, M.P., Moss, M., Flucomer, M., & Kleban, M.H. (1982). A research and service oriented multilevel assessment instrument. *Journal of Gerontology, 31*(1), 91-99.

Levin, W. E., & Unsworth, S. J. (2013). Do humans belong with nature? The influence of personal vs. abstract contexts on human-nature categorization at different stages of development. *Journal of Environmental Psychology*, *33*, 9–13. http://doi.org/10.1016/j.jenvp.2012.08.001

Little, T. D. (2013). *Longitudinal structural equation modeling.* New York, NY: The Guilford

Press.

Maas, J., Verheij, R. A., Vries, S. De, Spreeuwenberg, P., Schellevis, F. G., & Groenewegen, P. P. (2009). Morbidity is related to a green living environment. *Journal of Epidemiology and Community Health*, *63*, 967–973. http://doi.org/10.1136/jech.2008.079038

Mahalanobis, P.C. (1936). On the generalized distance in statistics. *Proceedings of the National Institute of Sciences of India*, 2, 49-55

Martyn, P. & Brymer, E. (2016). The relationship between nature relatedness and anxiety. *Journal of Health Psychology, 21*(7), 1436-1445.

Mayer, F.S., & Frantz, C.M. (2004). The connectedness to nature scale: A measure of individuals' feeling in community with nature. *Journal of Environmental Psychology, 24,* 503-515.

Mayer, F. S., Frantz, C. M., Bruehlman-Senecal, E., & Dolliver, K. (2009). Why Is Nature Beneficial?: The Role of Connectedness to Nature. *Environment and Behavior, 41*(5), 607–643. http://doi.org/10.1177/0013916508319745

Morganti, J.B., Nehrke, M.F., Hulicka, I.M., Caraldo, J.F. (1988). Life-span differences in life satisfaction, self-concept, and locus of control. *The International Journal of Aging and Human Development, 26,* 45-56.

Naess, A. (1988). Self realization: An ecological approach to being in the world. In J. Seed, J. Macy, P. Fleming, & A. Naess (Eds.). *Thinking like a Mountain: Towards a Council of All Beings.* New Society Publishers: Philadelphia, PA, pp. 19-30.

Nisbet, E. K., & Zelenski, J. M. (2013). The NR-6: a new brief measure of nature relatedness. *Frontiers in psychology*, *4*.

Nisbet, E. K. L., Zelenski, J. M., & Murphy, S. A. (2010). Happiness is in our nature: exploring nature relatedness as a contributor to subjective well-being. *Journal of Happiness Studies*, *12*, 303-322.

Okada, K. (2017). Negative estimate of variance-accounted for effect size: How often it is obtained, and what happens if it is treated as zero. *Behavioral Research, 49,* 979-987.

Pryor, A., Townsend, M., Maller, C., & Field, K. (2007). Health and well-being naturally 'Contact with nature' in health promotion for targeted individuals, communities and populations. *Health Promotion Journal of Australia*, *17*(2), 114–123.

Rentfrow, P.J., Mellander, C., & Florida, R. (2009). Happy states of America: A state-level analysis of psychological, economic, and social well-being. *Journal of Research in Personality*, *43*, 1073-1082.

Saw, L.E., Lim, F.K.S., Carrasco, L.R. (2015). The relationship between natural park usage and happiness does not hold in a tropical city-state. *PLOS One,* 16.

Schofield, M.J., & Mishra, G. (1998). Validity of the SF-12 compared with the SF-36 health survey in pilot studies of the Australian Longitudinal Study on women's health. *Journal of Health Psychology*, *3*(2), 259-271.

Schultz, P. W., Shriver, C., Tabanico, J. J., & Khazian, A. M. (2004). Implicit connections with nature. *Journal of Environmental Psychology*, 24, 31–42.

Seligman, M. E. P. (2011). *Flourish*. New York, NY: Simon & Schuster.

Shiota, M. N., Keltner, D., & John, O. P. (2006). Positive emotion dispositions differentially associated with Big Five personality and attachment style. *The Journal of Positive Psychology*, *1*, 61-71.

Singer, J.D., & Willett, J.B. (2003). *Applied longitudinal data analysis: Modeling change and event occurrence.* Oxford University Press: New York, NY.

Stahl, S. T., & Patrick, J. H. (2011). Adults' future time perspective predicts engagement in physical activity. *Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *67*(4), 413-416.

Tukey, J. (1949). Comparing individual means in the analysis of variance. *Biometrics, 5*, 99-114.

Twisk, J., & de Vente, W. (2002). Attrition in longitudinal studies: How to deal with missing data. *Journal of Clinical Epidemiology*, *55*, 329.337.

United States Census Bureau. (2018). *Census regions and divisions of the United States.* Retrieved from https://www2.census.gov/geo/pdfs/maps-data/maps/reference/us_regdiv.pdf

Verges, M., & Duff, S. (2010). Connected to birds but not bees: Valence moderates implicit associations with nature. *Environment and Behavior, 42*, 625-642.

Ware, J.E., Kosinski, M., & Keller, S. (1996). A 12-item short-form health survey: Construction of scales and preliminary tests of reliability and validity. *Medical Care, 34*, 220-233.

Wilson, E.O. (1984). *Biophilia.* Harvard University Press, Cambridge, MA.

Woodard, C. (2012). *American Nations: A History of the Eleven Rival Regional Cultures of North America*. Penguin Books: London, England.

Zelezny, L.C., Chua, P.P., Aldrich, C. (2000). Elaborating on gender differences in environmentalism. *Journal of Social Issues*, *56,* 443-457.

Table 1.
Demographic information per wave of data collection.

	DABS-I	DABS-II	DABS-III
Age	37.55 (SD = 15.64)	39.55 (SD = 15.22)	40.29 (SD = 14.70)
Gender	72.8% female	76.1% female	76.6 % female
Race	88.8% Caucasian; 2.6% African American; 3.3% Asian; 2.6% Biracial or multiracial; 2.6% prefer not to answer	88.6% Caucasian; 4.5% African American; 3.4% Asian; 1.1% Pacific Islander; 1.1 Biracial or multiracial; 1.1% prefer not to answer	88.3% Caucasian; 3.9% African American; 3.9% Asian; 2.6% Biracial or multiracial; 1.3% prefer not to answer
Location	4.8% West; 33.8% Midwest; 11.0% Northeast; 50.3% South	0.0% West; 27.3% Midwest; 13.6% Northeast; 59.1% South	1.3% West; 29.9% Midwest; 9.1% Northeast; 59.7% South

Table 2.
Means, standard deviations, and alphas for CNS, and measures of well-being

	DABS-I (N = 152; 2015)			DABS-II (N = 88; 2016)			DABS-III (N = 77; 2017)		
	M	SD	α	M	SD	α	M	SD	α
Connectedness to Nature	48.80	9.74	.89	47.64	10.01	.88	50.05	9.73	.89
Positive Affect	18.10	2.93	.74	17.51	3.60	.82	17.82	3.19	.79
Negative Affect	13.87	3.04	.70	11.82	3.88	.82	12.04	3.62	.82
Life Satisfaction	23.21	6.38	.84	24.60	6.75	.88	24.71	6.54	.89
SF12	7.05	.76	.73	7.01	.75	.73	6.98	.69	.69

Note. Scores in parenthesis for the SF12 represent scores after a square root transformation.

Table 3.

Results of t-test and descriptive statistics for CN, SWLS, PA, NA, and SF12 by participants who completed the study versus ones of you did not complete the study.

	Attrition							
	Completed ONLY DABS-I			Completed more than one wave				
	M	SD	n	M	SD	n	t	*p*
CN	50.00	10.39	51	48.15	9.39	101	1.15	.25
SWLS	22.50	7.21	51	23.55	5.94	100	-0.96	.34
PA	18.34	3.11	51	17.98	2.85	100	0.71	.48
NA	14.16	3.13	51	13.72	3.00	100	0.83	.41
SF12	7.010	0.81	51	7.06	0.73	101	-0.41	.69

Table 4.

Correlations for age, gender, location, CN, SWLS, PA, NA, and SF12

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1) Age (DABS-I)	-																
2) Gender (DABS-I)	.15	-															
3) Location (DABS-I)	**-.31**	.01	-														
4) CNS (DABS-I)	**.16**	-.02	-.14	-													
5) CNS (DABS-II)	.08	-.03	-.10	**.78**	-												
6) CNS (DABS-III)	.13	-.02	-.23	**.85**	**.85**	-											
7) SWLS (DABS-I)	**-.20**	-.02	**.21**	.07	.14	.17	-										
8) SWLS (DABS-II)	**-.30**	-.06	**.26**	.04	**.21**	.15	**.64**	-									
9) SWLS (DABS-III)	-.19	-.04	.17	.07	.24	.18	**.61**	**.68**	-								
10) PA (DABS-I)	**-.18**	-.11	.18	**.31**	.18	**.28**	**.54**	**.34**	**.42**	-							
11) PA (DABS-II)	-.14	-.04	.11	.07	**.28**	.24	**.45**	**.62**	**.57**	**.36**	-						
12) PA (DABS-III)	-.02	.10	.08	.12	.23	**.28**	**.40**	**.33**	**.66**	**.48**	**.53**	-					
13) NA (DABS-I)	.04	.03	**-.18**	.00	-.10	.12	**-.45**	**-.48**	**-.37**	**-.46**	**-.39**	**-.25**	-				
14) NA (DABS-II)	.06	-.12	-.13	.01	-.18	-.02	**-.28**	**-.54**	**-.35**	-.08	**-.59**	**-.40**	**.41**	-			
15) NA (DABS-III)	.15	-.05	-.08	.07	-.10	-.04	**-.35**	-.17	**-.56**	**-.25**	-.14	**-.48**	**.31**	**.47**	-		
16) SF12 (DABS-I)	**-.40**	-.04	-.02	.02	.01	-.03	**.21**	**.30**	.20	**.21**	.16	.02	-.05	-.21	-.15	-	
17) SF12 (DABS-II)	**-.52**	-.20	.23	-.10	-.02	-.06	**.26**	**.38**	.12	**.26**	.15	-.07	**-.22**	-.13	-.12	**.66**	-
18) SF12 (DABS-III)	**-.50**	-.17	.08	.10	.08	.18	**.29**	.24	**.31**	**.34**	.18	**.24**	-.03	.02	-.19	**.67**	**.80**

Note. Bold (p < .05). All correlations with gender and location are Spearman Rho and all other correlations are Pearson r. Cell sizes within the correlations vary from n = 61 to n = 151.

Table 5.

Standard regression coefficients for the association of CN, PA, age, location, and gender.

	B	SE(B)	β	C.R.	*p*
CNS DABS-I to CNS DABS-II	0.81	0.07	.79	11.74	.001
CNS DABS-II to CNS DABS-III	0.84	0.06	.85	12.98	.001
PA DABS-I TO PA DABS II	0.52	0.13	.42	4.18	.001
PA DABS-II TO PA DABS III	0.54	0.09	.60	6.24	.001
CNS DABS-I TO PA DABS-II	-0.01	0.04	-.03	-0.32	.75
PA DABS-I TO CNS DABS-II	-0.04	0.23	-.01	-0.17	.87
CNS DABS-II TO PA DABS-III	0.03	0.03	.09	0.95	.34
PA DABS-II TO CNS DABS-III	0.11	0.18	.04	0.63	.53
AGE TO CNS DABS-I	0.10	0.05	.16	2.03	.04
AGE TO PA DABS-I	-0.03	0.02	-.18	-2.23	.03
GENDER TO CNS DABS-I	.00	1.78	.00	.00	1.00
GENDER TO PA DABS-I	-0.67	0.54	-.10	-1.25	.21
LOCATION TO CNS DABS-I	-2.24	1.78	-.11	-1.26	.21
LOCATION TO PA DABS-I	1.13	0.53	.19	2.14	.03

Table 6.

Standard regression coefficients for the association of CN, NA, age, location, and gender.

	B	SE(B)	β	C.R.	*p*
CNS DABS-I to CNS DABS-II	0.81	0.06	.79	12.71	.001
CNS DABS-II to CNS DABS-III	0.86	0.06	.86	13.57	.001
NA DABS-I TO NA DABS II	0.63	0.12	.48	5.22	.001
NA DABS-II TO NA DABS III	0.54	0.09	.58	5.91	.001
CNS DABS-I TO NA DABS-II	-0.01	0.04	-.02	-0.16	.87
NA DABS-I TO CNS DABS-II	-0.41	0.21	-.13	-2.02	.04
CNS DABS-II TO NA DABS-III	-0.01	0.04	-.03	-0.27	.79
NA DABS-II TO CNS DABS-III	0.38	0.16	.15	2.36	.02
AGE TO CNS DABS-I	0.10	0.05	.16	2.03	.04
AGE TO NA DABS-I	0.01	0.02	.04	0.48	.63
GENDER TO CNS DABS-I	0.01	1.78	.001	0.01	.99
GENDER TO NA DABS-I	0.06	0.56	.01	0.1	.92
LOCATION TO CNS DABS-I	-2.36	1.77	-.12	-1.34	.18
LOCATION TO NA DABS-I	-1.20	0.55	-.20	-2.2	.03

Table 7.

Standard regression coefficients for the association of CN, SWLS, age, location, and gender

	B	SE(B)	β	C.R.	*p*
CNS DABS-I to CNS DABS-II	0.81	0.07	.79	12.29	.001
CNS DABS-II to CNS DABS-III	0.85	0.06	.85	13.11	.001
SWLS DABS-I TO SWLS DABS II	0.83	0.09	.71	9.68	.001
SWLS DABS-II TO SWLS DABS III	0.72	0.07	.78	10.32	.001
CNS DABS-I TO SWLS DABS-II	-0.08	0.06	-.10	-1.4	.16
SWLS DABS-I TO CNS DABS-II	-0.01	0.10	-.004	-0.07	.95
CNS DABS-II TO SWLS DABS-III	0.04	0.05	.06	0.85	.40
SWLS DABS-II TO CNS DABS-III	-0.04	0.09	-.03	-0.41	.69
AGE TO CNS DABS-I	0.10	0.05	.16	2.03	.04
AGE TO SWLS DABS-I	-0.08	0.03	-.20	-2.48	.01
GENDER TO CNS DABS-I	0.01	1.78	.001	0.01	.99
GENDER TO SWLS DABS-I	-0.02	1.17	-.001	-0.01	.99
LOCATION TO CNS DABS-I	-2.22	1.77	-.11	-1.25	.21
LOCATION TO SWLS DABS-I	2.99	1.14	.23	2.63	.01

Table 8.

Standard regression coefficients for the association of CN, SF12, age, location, and gender.

	B	SE(B)	β	C.R.	*p*
CNS DABS-I to CNS DABS-II	0.81	0.07	.79	12.34	.001
CNS DABS-II to CNS DABS-III	0.84	0.06	.85	13.07	.001
SF12 DABS-I TO SF12 DABS II	0.66	0.07	.67	8.98	.001
SF12 DABS-II TO SF12 DABS III	0.76	0.07	.82	11.55	.001
CNS DABS-I TO SF12 DABS-II	-0.01	0.01	-.14	-1.79	.07
SF12 DABS-I TO CNS DABS-II	-0.32	0.84	-.03	-0.39	.70
CNS DABS-II TO SF12 DABS-III	0.01	0.01	.16	2.22	.03
SF12 DABS-II TO CNS DABS-III	0.32	0.87	.05	0.36	.72
AGE TO CNS DABS-I	0.10	0.05	.16	2.03	.04
AGE TO NA DABS-I	-0.02	0.004	-.40	-5.31	.001
GENDER TO CNS DABS-I	0.01	1.78	.001	0.01	1.00
GENDER TO PA DABS-I	-0.12	0.14	-.07	-0.83	.41
LOCATION TO CNS DABS-I	-2.40	1.78	-.12	-1.35	.18
LOCATION TO PA DABS-I	0.04	0.14	.02	0.26	.80

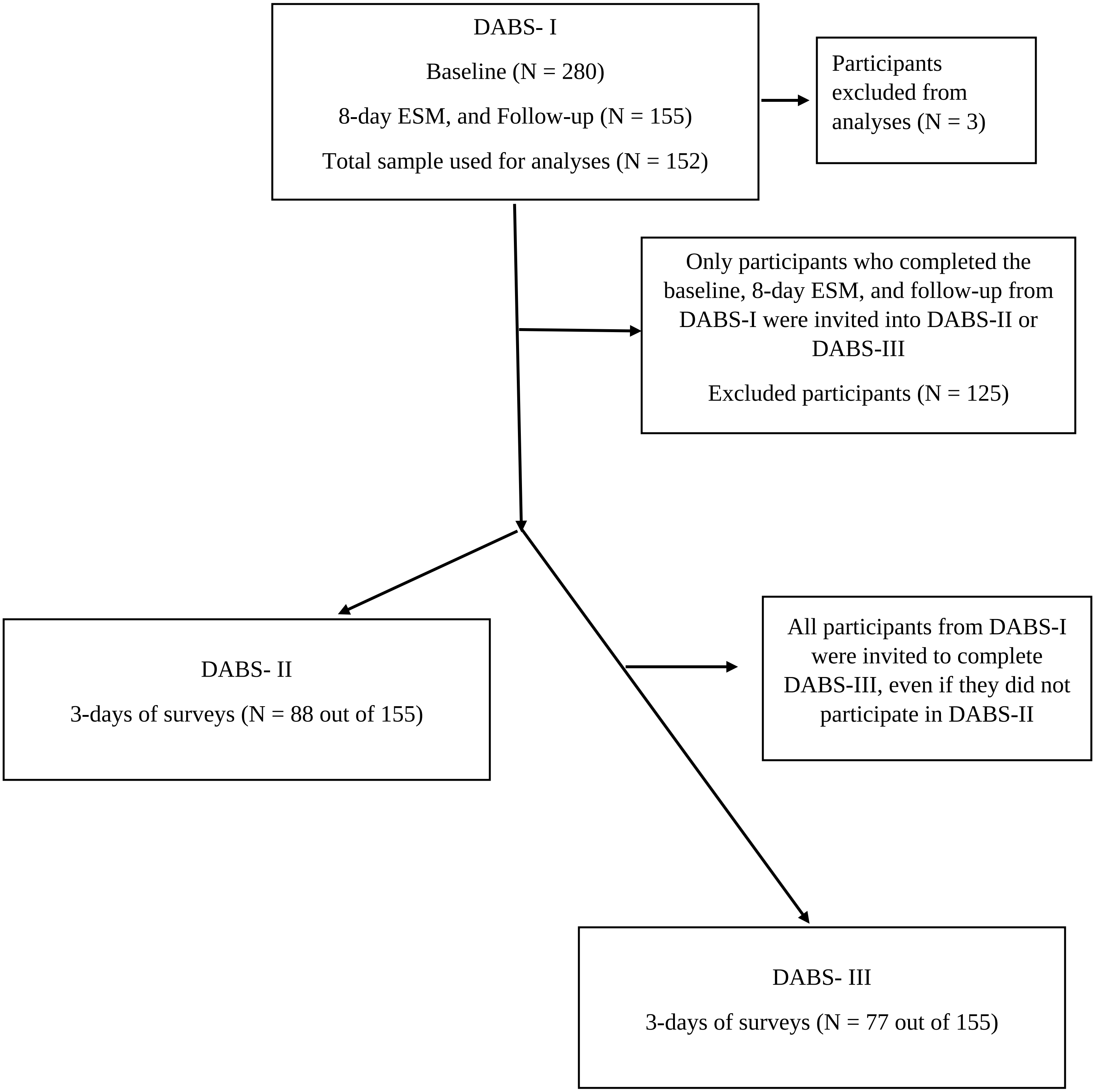

Figure 1. Flow chart of data collection and participants.

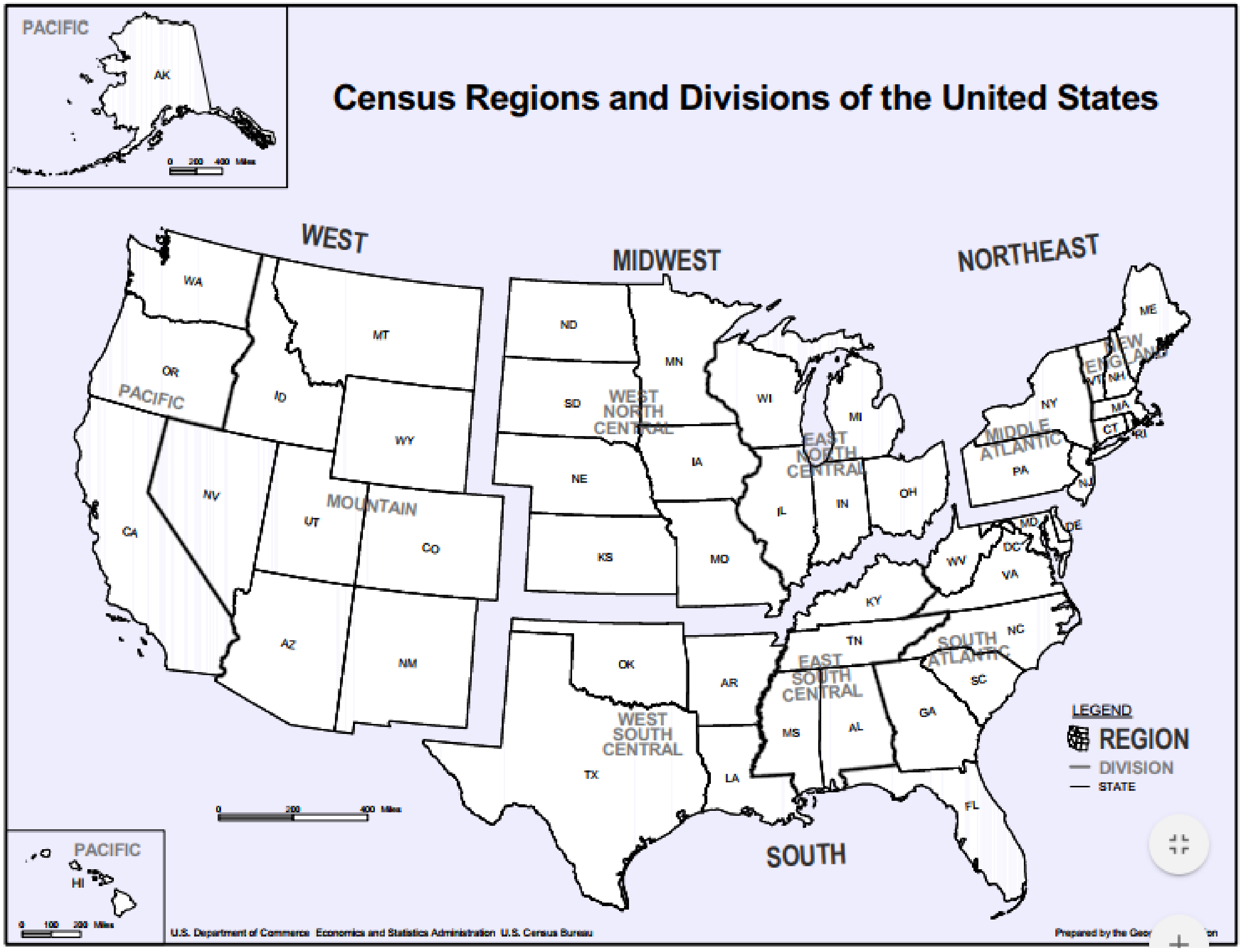

Figure 2. Census regions of the United States from https://www2.census.gov/geo/pdfs/maps-data/maps/reference/us_regdiv.pdf

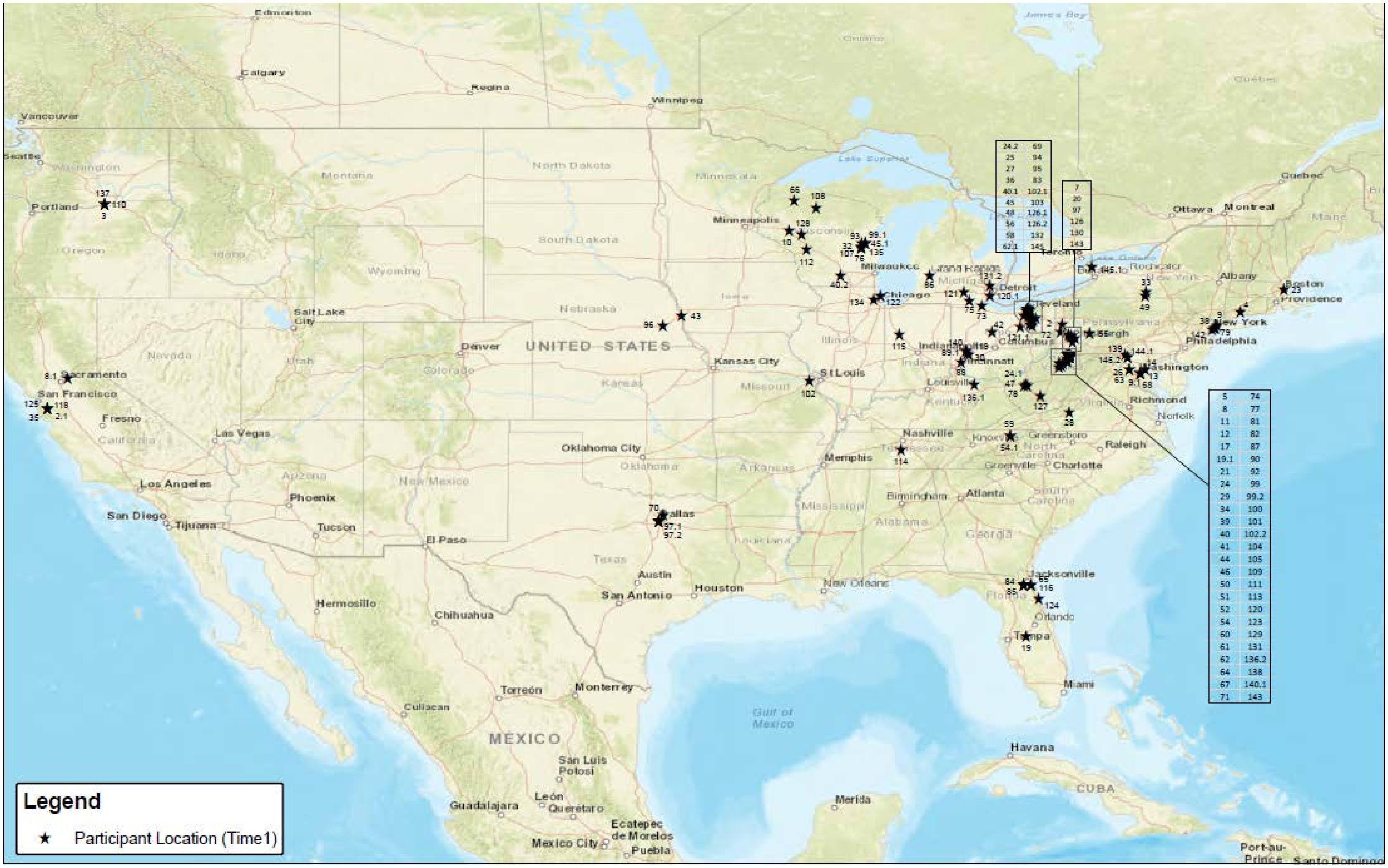

Figure 3. Participant location at DABS-I

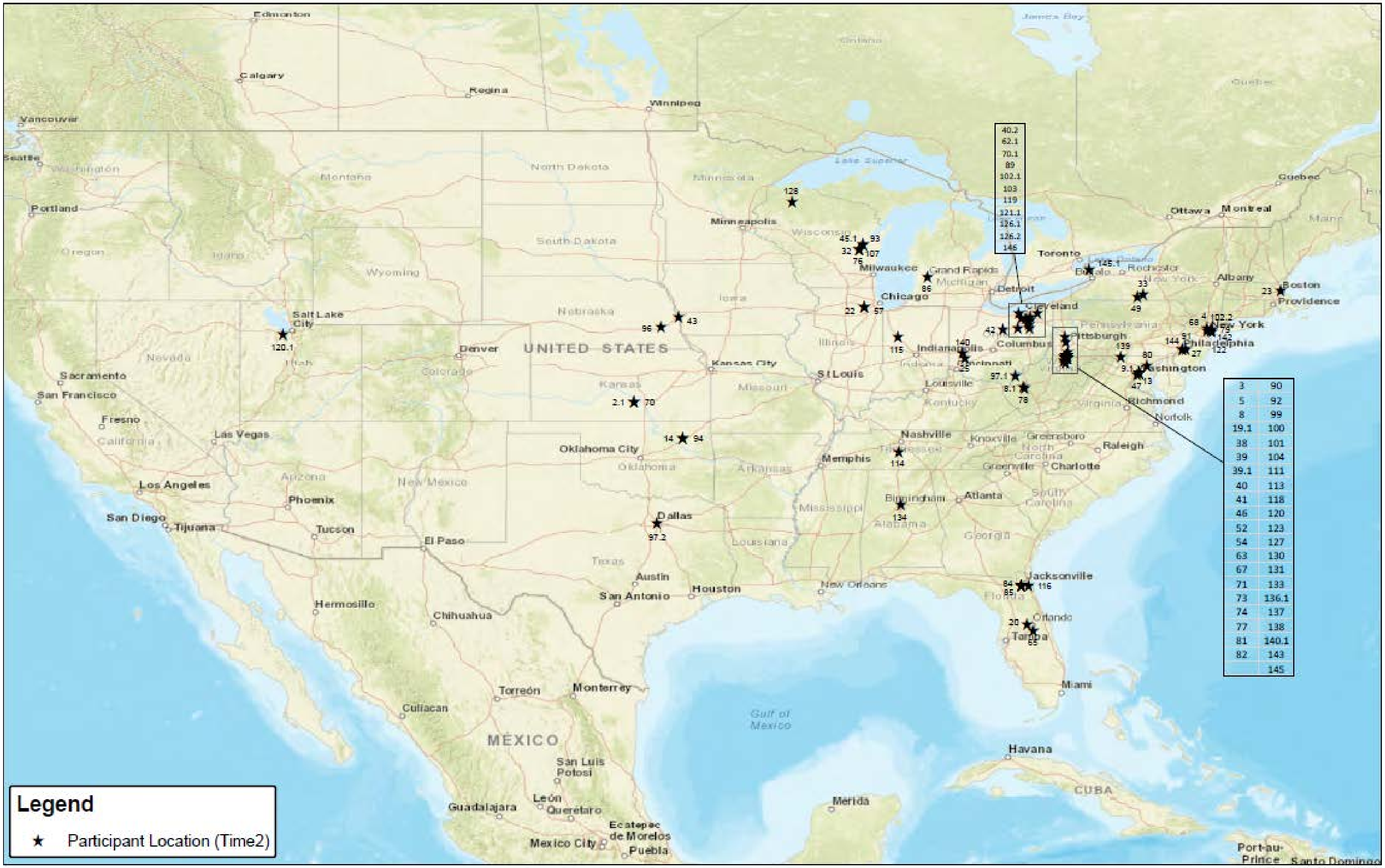

Figure 4. Participant location at DABS-II

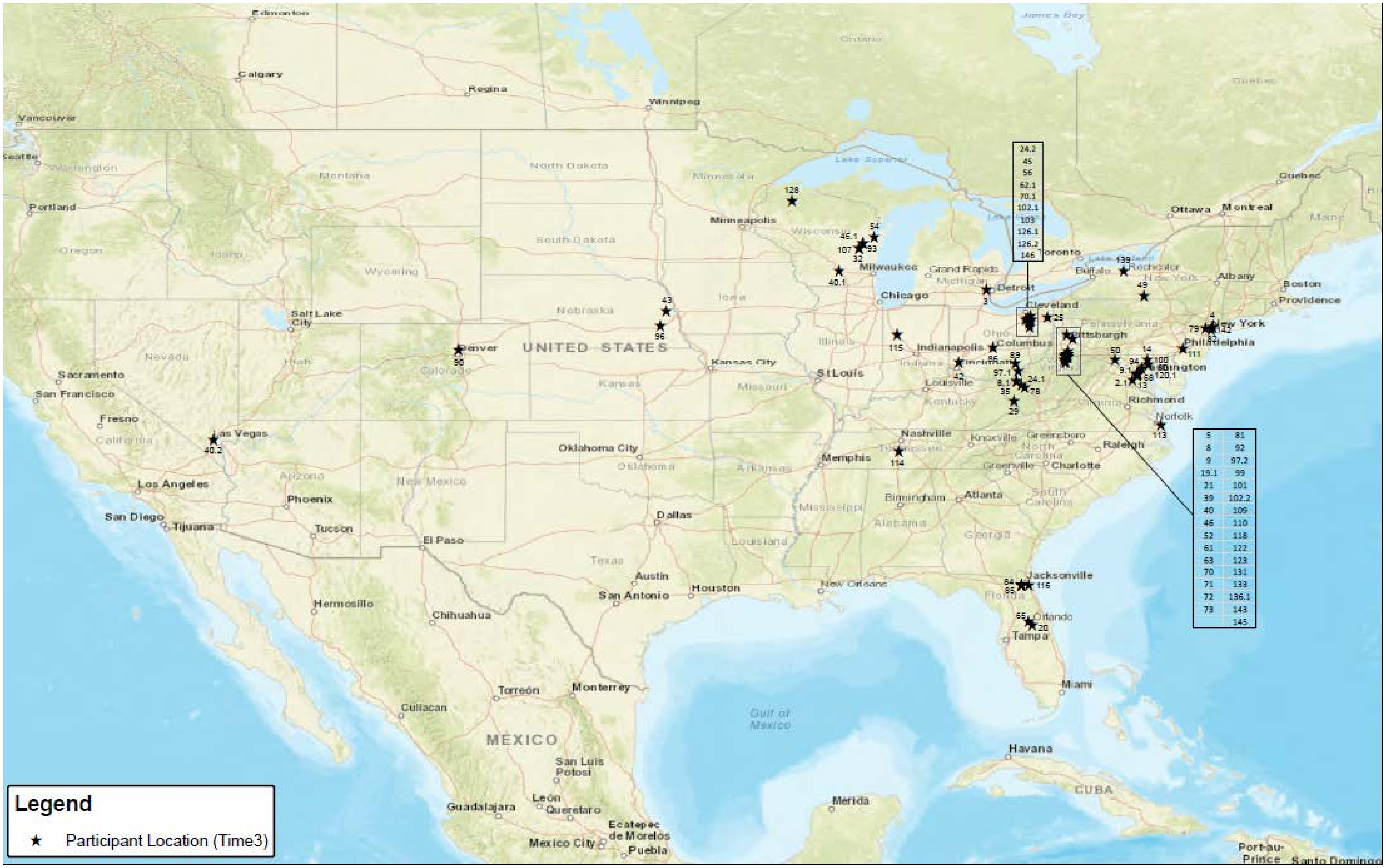

Figure 5. Participant location at DABS-III

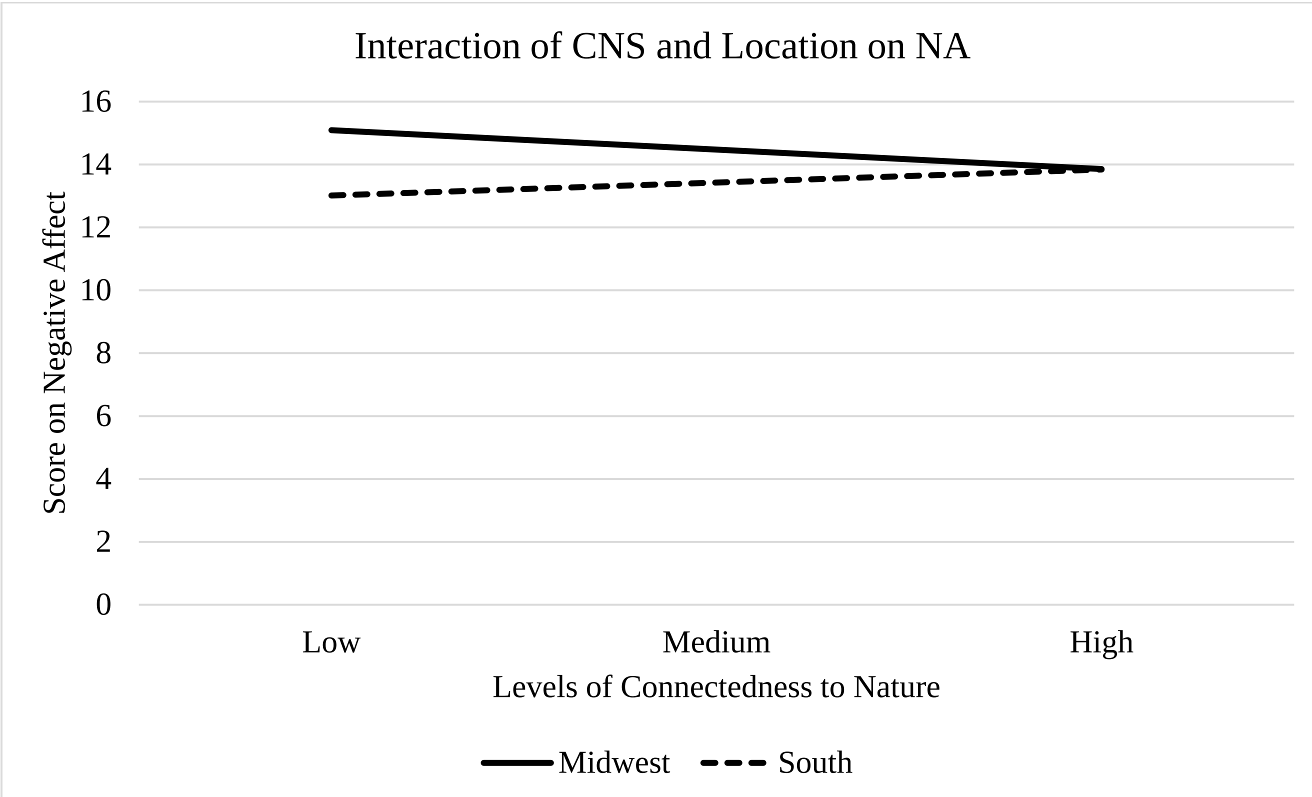

Figure 6. Graph of the interaction between connectedness to nature and location on negative affect.

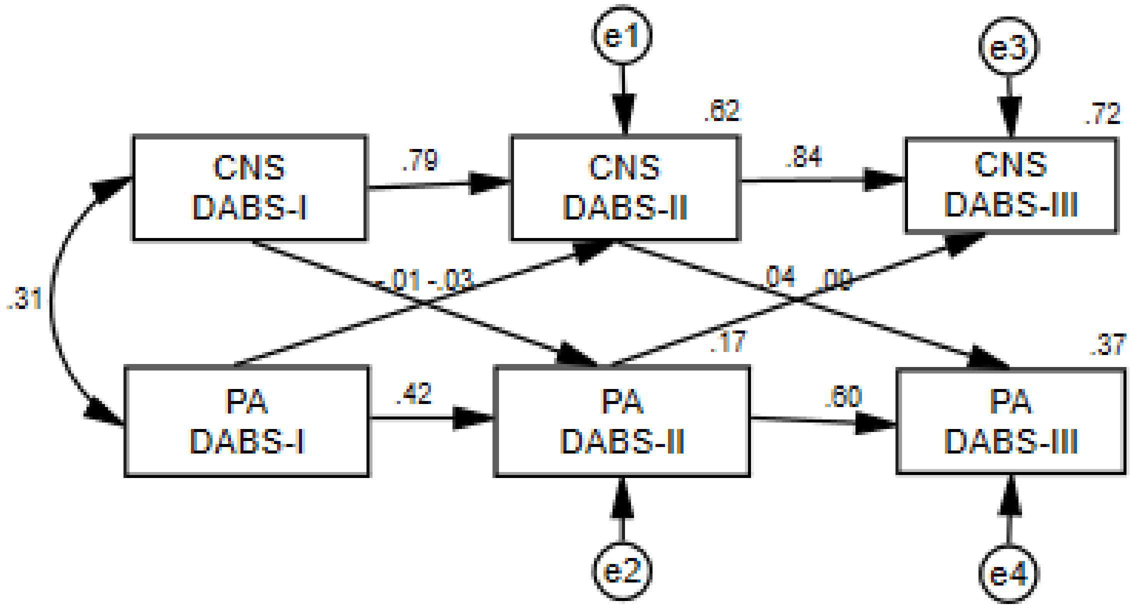

Figure 7. Cross-lagged path analysis for connectedness to nature and positive affect, with standardized regression weights.

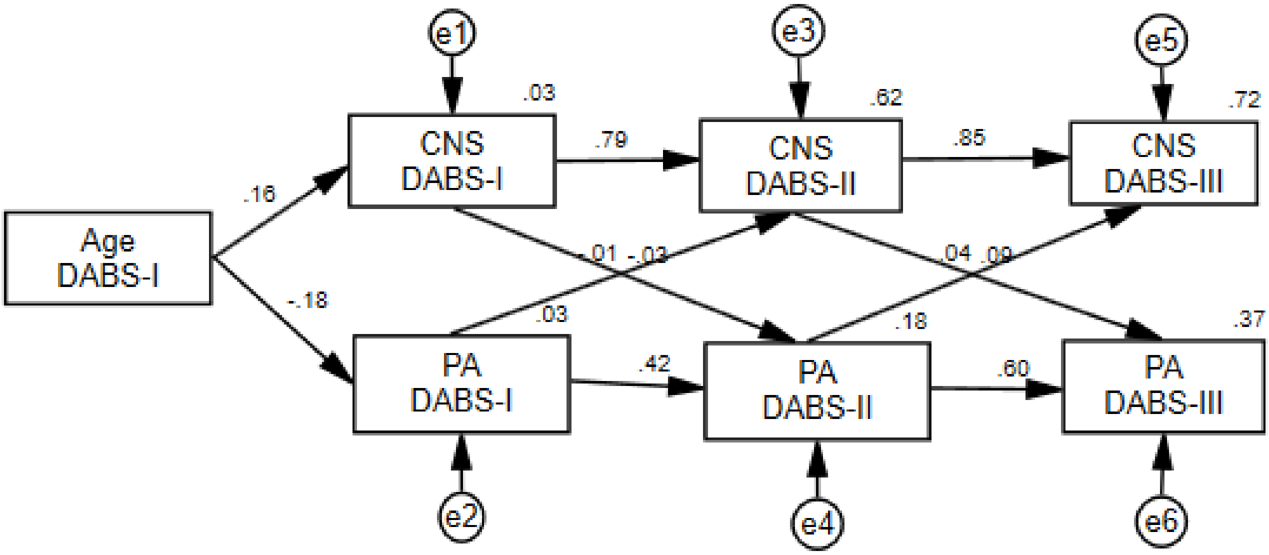

Figure 8. Cross-lagged path analysis, with standardized regression weights, for connectedness to nature and positive affect with age as a covariate.

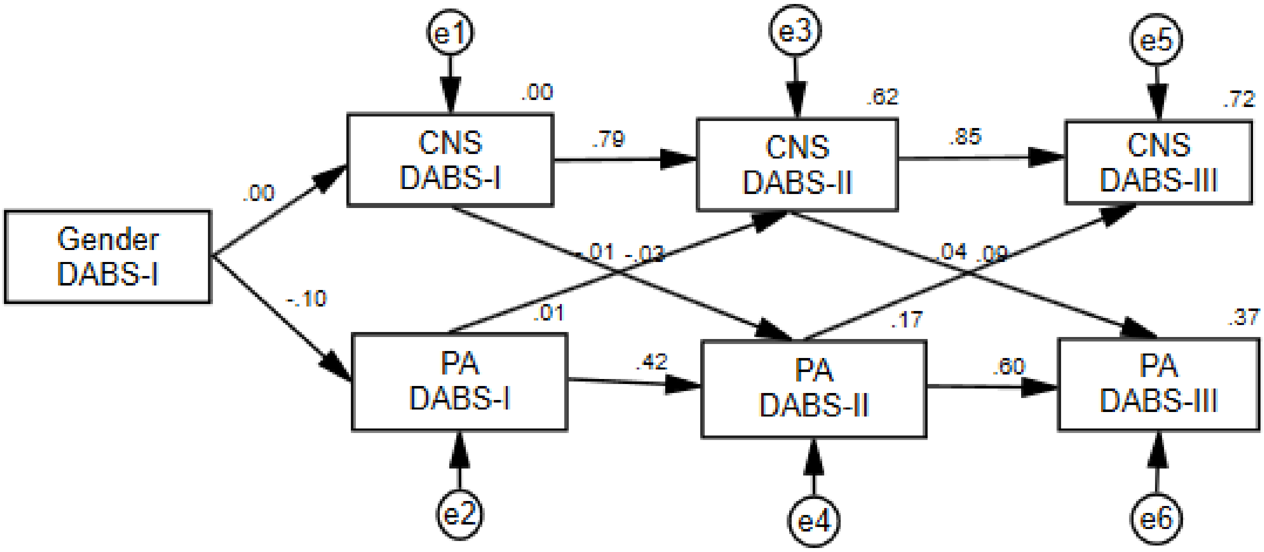

Figure 9. Cross-lagged path analysis, with standardized regression weights, for connectedness to nature and positive affect with gender (0 = female, 1 = male) as a covariate.

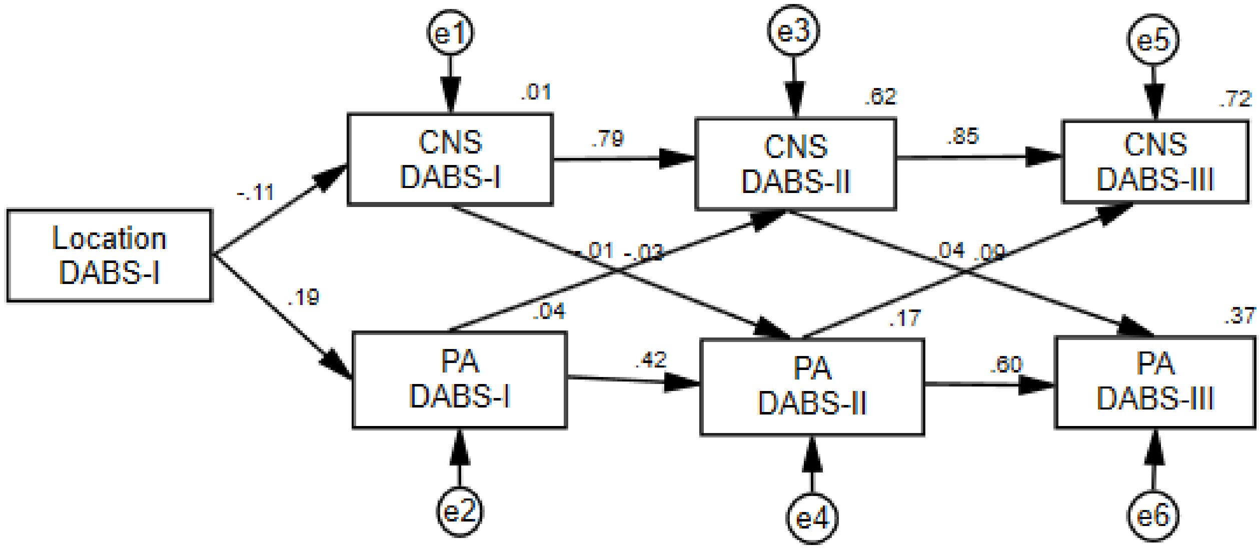

Figure 10. Cross-lagged path analysis, with standardized regression weights, for connectedness to nature and positive affect with location (0 = Midwest, 1 = South) as a covariate.

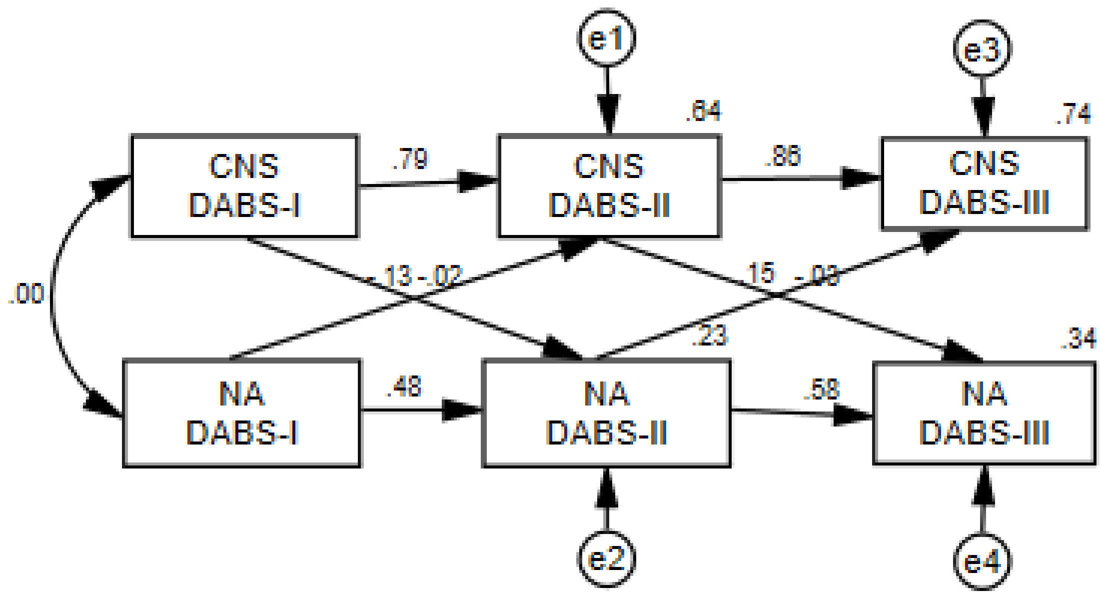

Figure 11. Cross-lagged path analysis for connectedness to nature and negative affect, with standardized regression weights.

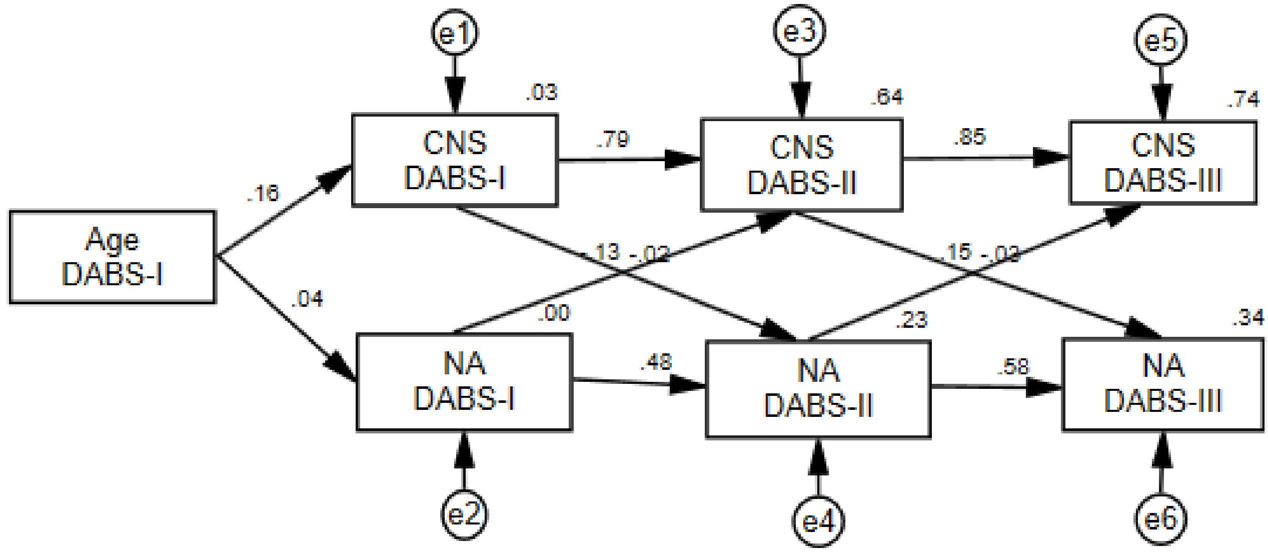

Figure 12. Cross-lagged path analysis, with standardized regression weights, for connectedness to nature and negative affect with age as a covariate.

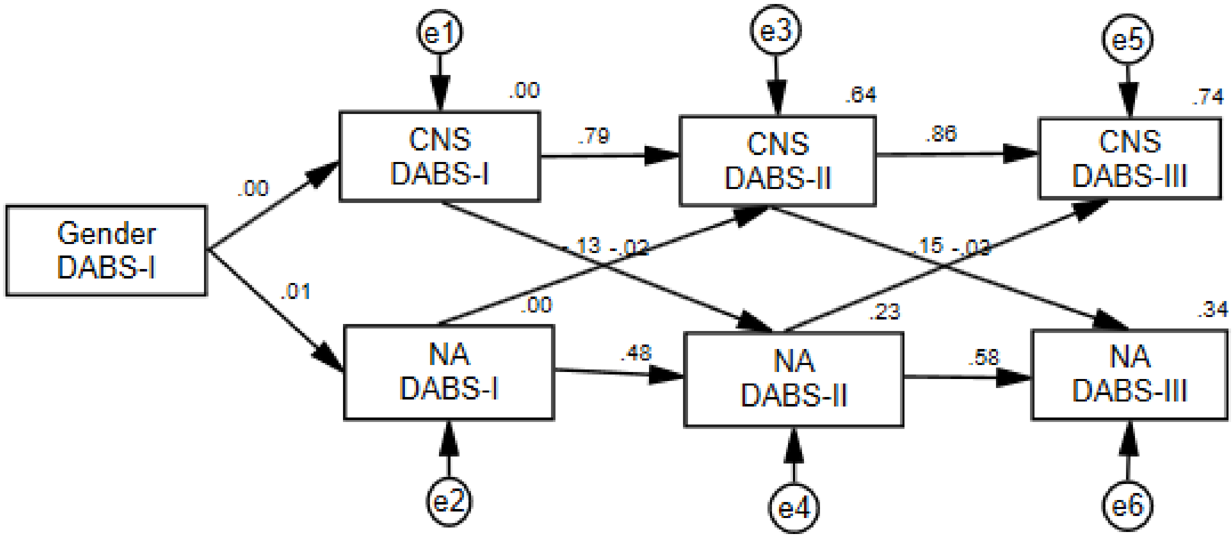

Figure 13. Cross-lagged path analysis, with standardized regression weights, for connectedness to nature and negative affect with gender (0 = female, 1 = male) as a covariate.

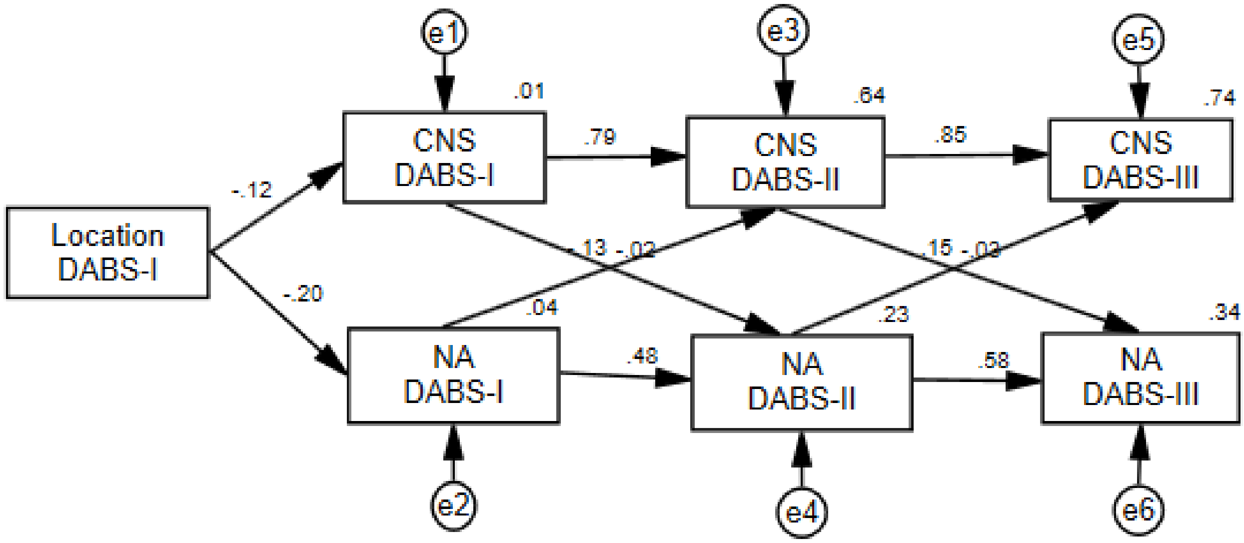

Figure 14. Cross-lagged path analysis, with standardized regression weights, for connectedness to nature and negative affect with location (0 = Midwest, 1 = South) as a covariate.

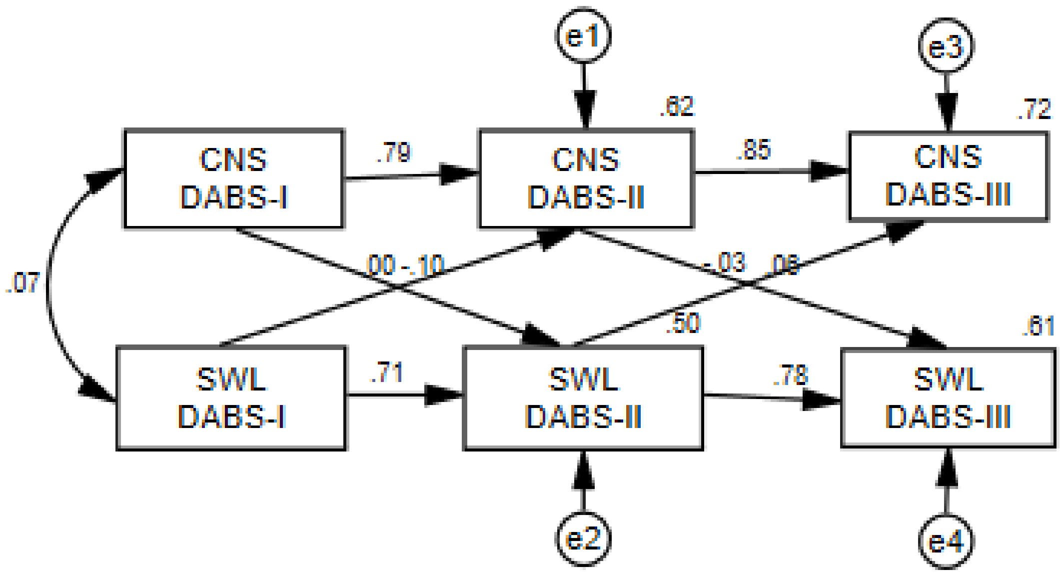

Figure 15. Cross-lagged path analysis for connectedness to nature and life satisfaction, with standardized regression weights.

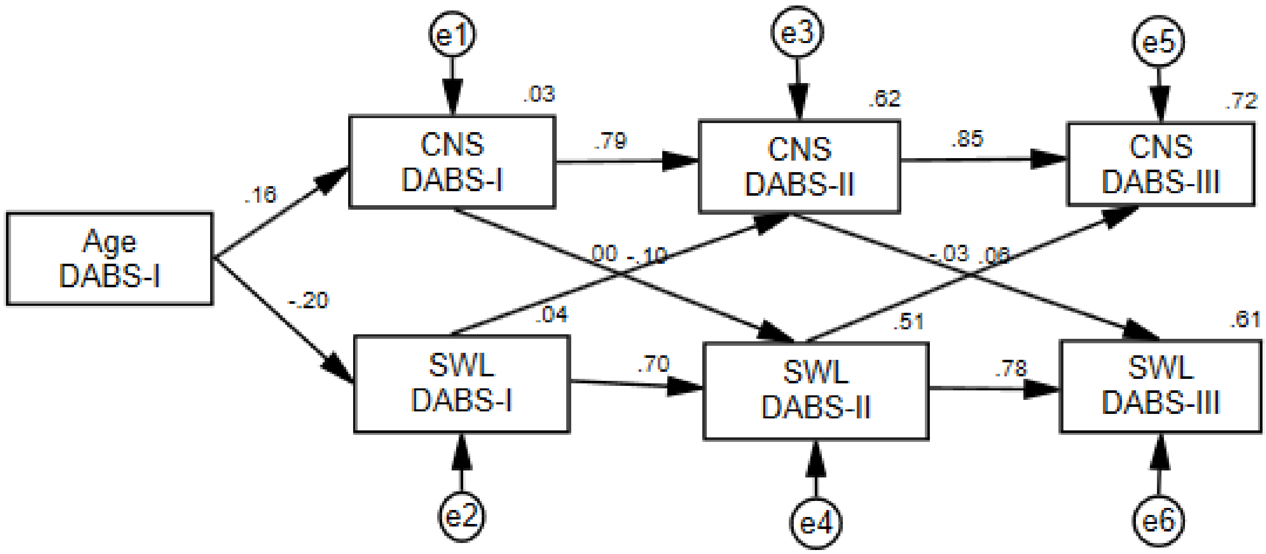

Figure 16. Cross-lagged path analysis, with standardized regression weights, for connectedness to nature and life satisfaction with age as a covariate.

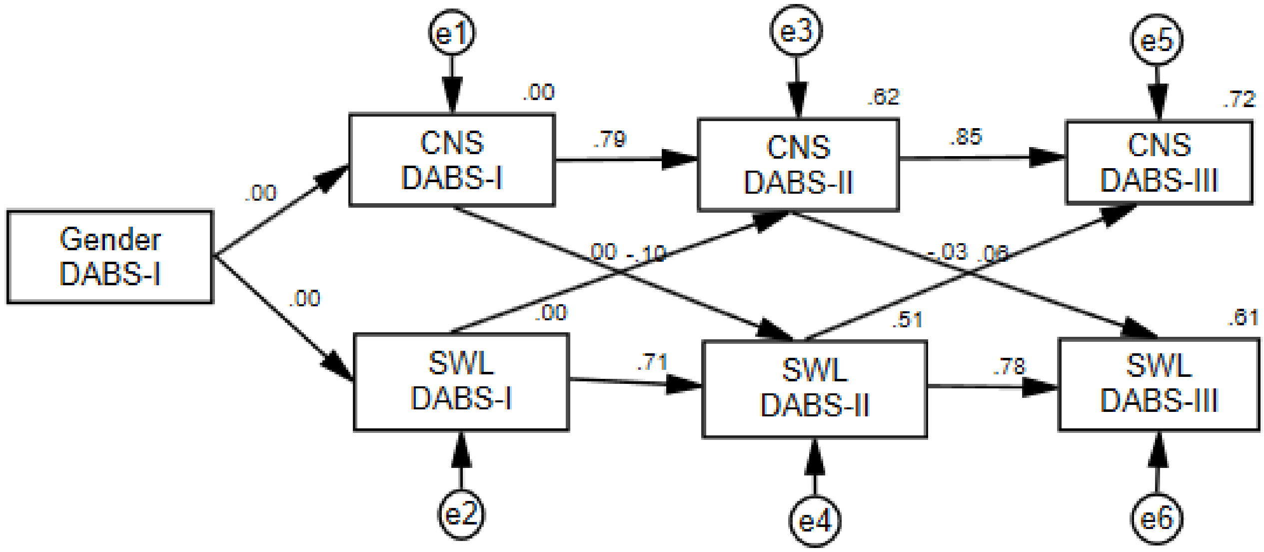

Figure 17. Cross-lagged path analysis, with standardized regression weights, for connectedness to nature and life satisfaction with gender (0 = female, 1 = male) as a covariate.

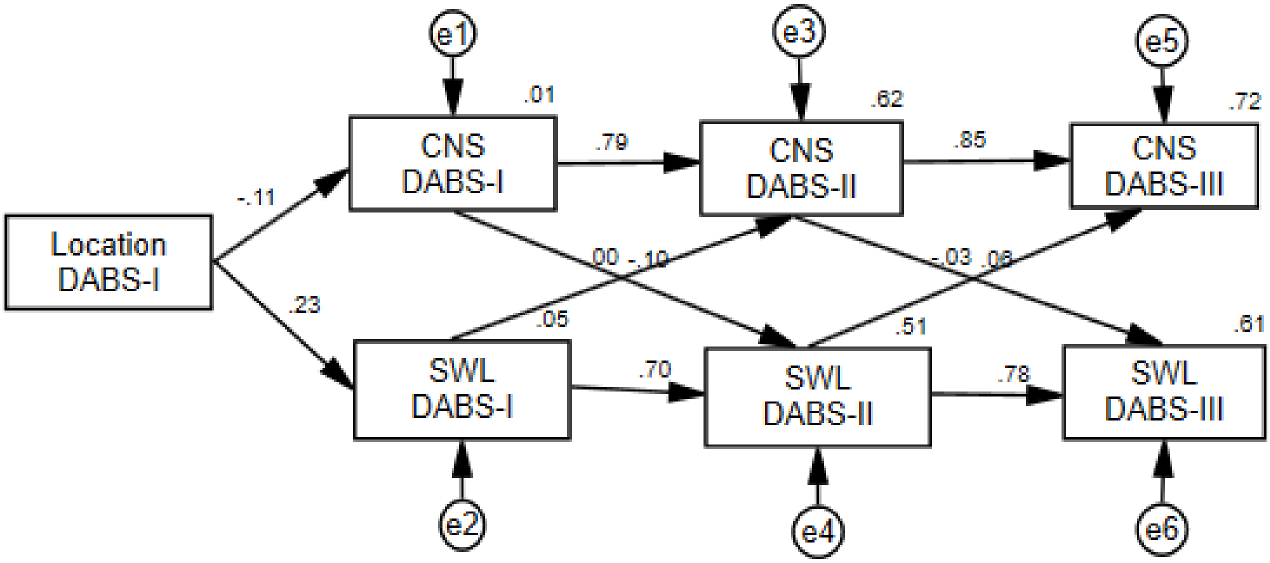

Figure 18. Cross-lagged path analysis, with standardized regression weights, for connectedness to nature and life satisfaction with location (0 = Midwest, 1 = South) as a covariate.

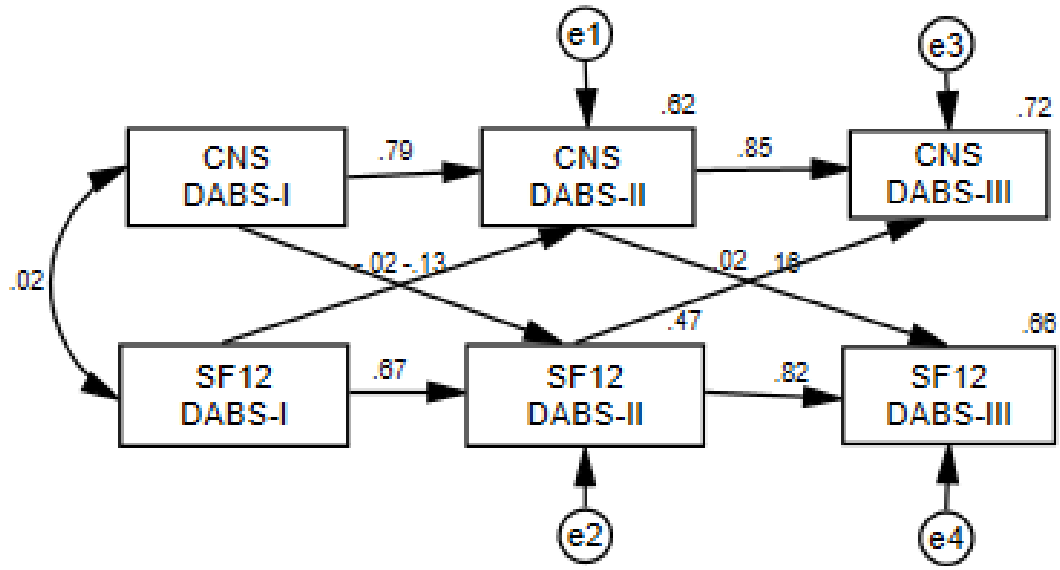

Figure 19. Cross-lagged path analysis for connectedness to nature and subjective physical well-being, with standardized regression weights.

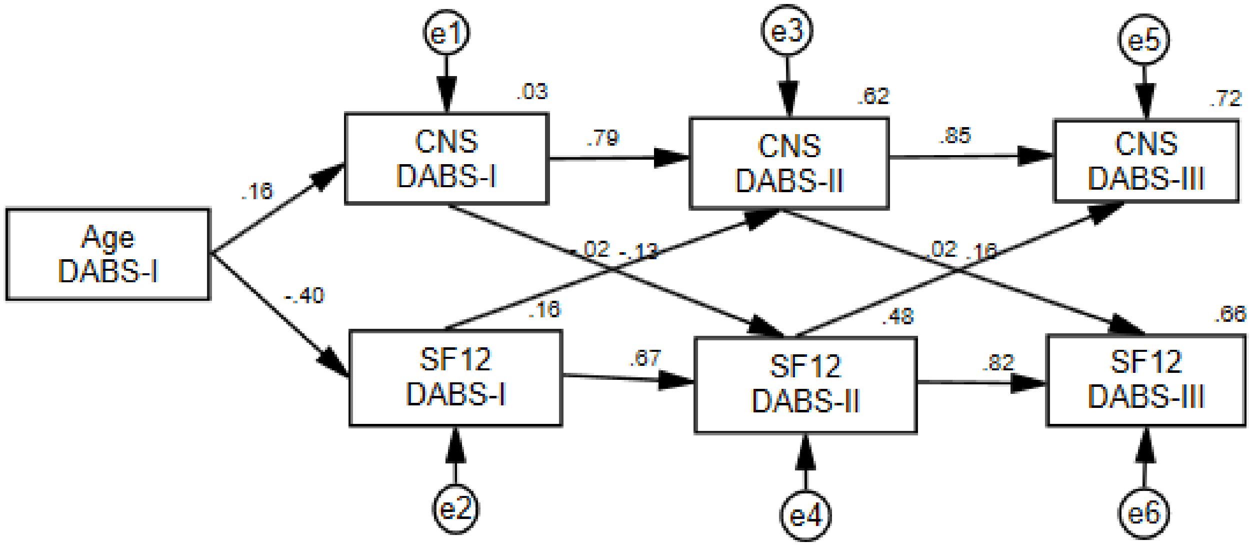

Figure 20. Cross-lagged path analysis, with standardized regression weights, for connectedness to nature and subjective physical well-being with age as a covariate.

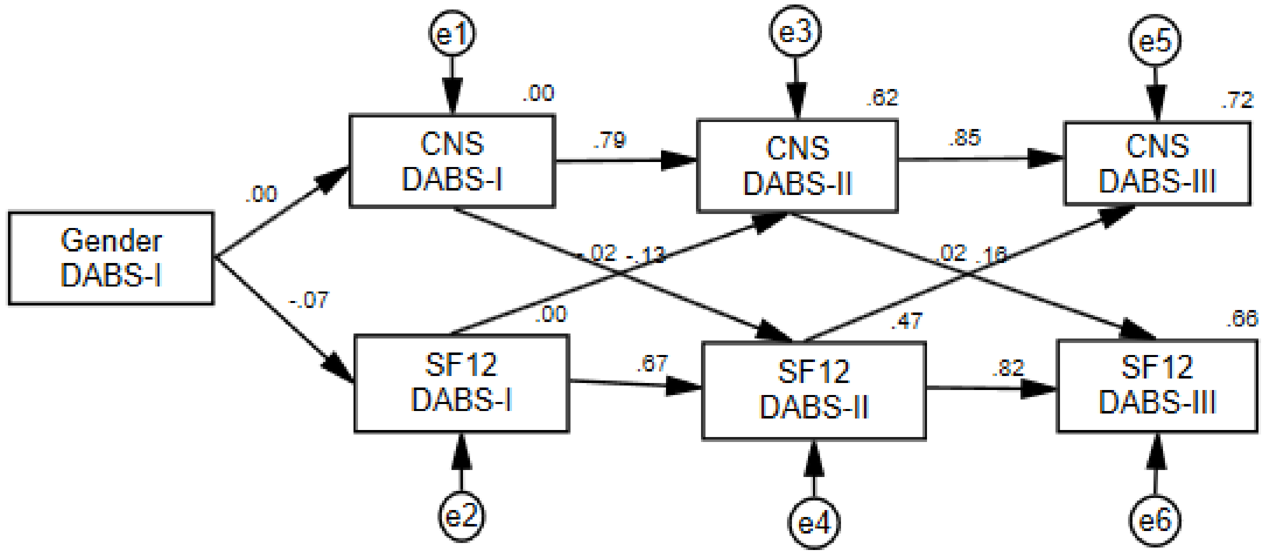

Figure 21. Cross-lagged path analysis, with standardized regression weights, for connectedness to nature and subjective physical well-being with gender (0 = female, 1 = male) as a covariate.

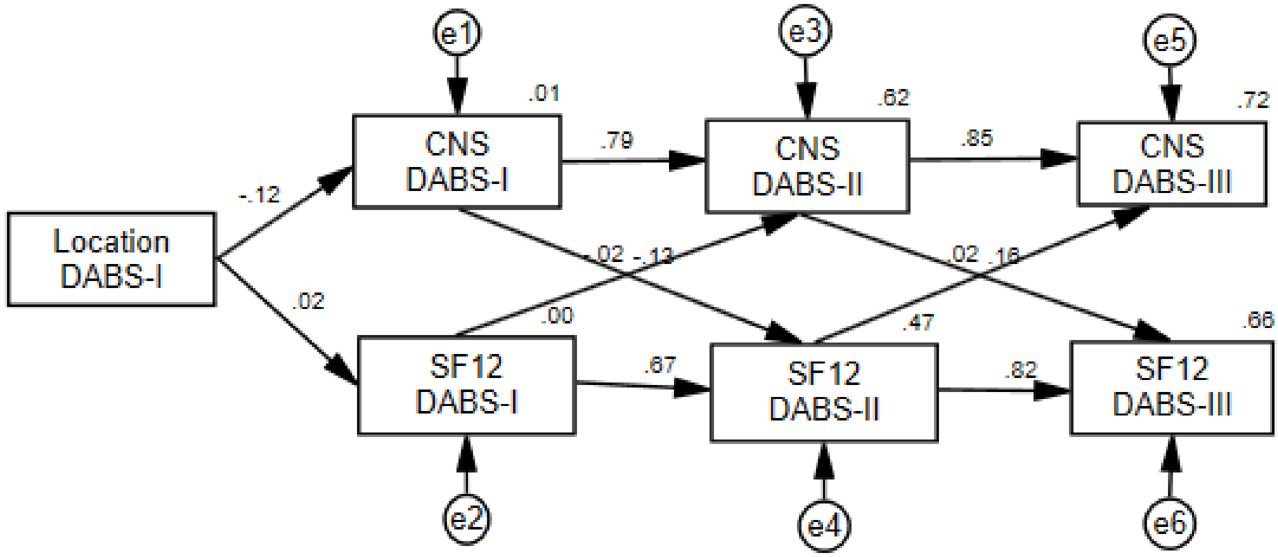

Figure 22. Cross-lagged path analysis, with standardized regression weights, for connectedness to nature and subjective physical well-being with location (0 = Midwest, 1 = South) as a covariate.

Appendix A

Connectedness to nature; CNS.
Mayer and Frantz (2004)

Please answer each of these questions in terms of the way you generally feel. There are no right or wrong answers. Using the following scale, simply state as honestly and candidly as you can what you are presently experiencing

	Strongly Disagree 1 (1)	2 (2)	Neutral 3 (3)	4 (4)	Strongly Agree (5)
I often feel a sense of oneness with the natural world around me. (1)	o	o	o	o	o
I think of the natural world as a community to which I belong. (2)	o	o	o	o	o
I recognize and appreciate the intelligence of other living organisms. (3)	o	o	o	o	o
I often feel disconnected from nature. (4)	o	o	o	o	o
When I think of my life, I imagine myself to be part of a larger cyclical process of living. (5)	o	o	o	o	o
I often feel a kinship with animals and plants. (6)	o	o	o	o	o
I feel as though I belong to the Earth as equally as it belongs to me. (7)	o	o	o	o	o
I have a deep understanding of how my actions affect the natural world. (8)	o	o	o	o	o
I often feel part of the web of life. (9)	o	o	o	o	o
I feel that all inhabitants of Earth, human, and nonhuman, share a common ‘life force’. (10)	o	o	o	o	o
Like a tree can be part of a forest, I feel embedded within the broader natural world. (11)	o	o	o	o	o

When I think of my place on Earth, I consider myself to be a top member of a hierarchy that exists in nature. (12)	o	o	o	o	o
I often feel like I am only a small part of the natural world around me, and that I am no more important than the grass on the ground or the birds in the trees. (13)	o	o	o	o	o
My personal welfare is independent of the welfare of the natural world. (14)	o	o	o	o	o

Emotional Well-Being; Life Satisfaction: The satisfaction with life scale

(SWLS; Diener et al., 1985)

Next are statements with which you may agree or disagree. Please indicate your agreement with each item.

	Strongly Disagree (1)	Disagree (2)	Slightly Disagree (3)	Neither Agree nor Disagree (4)	Slightly Agree (5)	Agree (6)	Strongly Agree (7)
In most ways my life is close to my ideal. (1)	o	o	o	o	o	o	o
The conditions of my life are excellent. (2)	o	o	o	o	o	o	o
I am satisfied with my life. (3)	o	o	o	o	o	o	o
So far I have gotten the important things I want in life. (4)	o	o	o	o	o	o	o
If I could live my life over, I would change almost nothing. (5)	o	o	o	o	o	o	o

Emotional Well-Being; Positive and Negative Affect. The Philadelphia Geriatric Center Positive (PA) and Negative (NA) Affect Scales

(Lawton, Kleban, Dean, Rajagopal, & Parmelee, 1992)

How often during the PAST WEEK did you feel:

	Never (1)	Rarely (2)	Sometimes (3)	Frequently (4)	Very Frequently (5)
Happy (1)	o	o	o	o	o
Annoyed (2)	o	o	o	o	o
Warm-hearted (3)	o	o	o	o	o
Irritated (4)	o	o	o	o	o
Content (5)	o	o	o	o	o
Sad (6)	o	o	o	o	o
Energetic (7)	o	o	o	o	o
Worried (8)	o	o	o	o	o
Interested (9)	o	o	o	o	o
Depressed (10)	o	o	o	o	o

Subjective physical well-being; SF12. The 12-item short-form health survey

(Ware, Kosinski, & Keller, 1996)

1) In general, would you say your health is:

- o Poor (1)
- o Fair (2)
- o Good (3)
- o Very Good (4)
- o Excellent (5)

2) The following two questions are about activities you might do during a typical day. Does YOURHEALTH NOW LIMIT YOU in these activities? If so, how much?

	Yes, Limited a Lot (1)	Yes, Limited a Little (2)	No, Not Limited at All (3)
MODERATE ACTIVITIES, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf (2)	o	o	o
Climbing SEVERAL flights of stairs (3)	o	o	o

4) During the PAST 4 WEEKS have you had any of the following problems with your work or other regular activities AS A RESULT OF YOUR PHYSICAL HEALTH? ACCOMPLISHED LESS than you would like:

- o Yes (1)
- o No (2)

5) During the PAST 4 WEEKS have you had any of the following problems with your work or other regular activities AS A RESULT OF YOUR PHYSICAL HEALTH? ACCOMPLISHED LESS than you would like:Were limited in the KIND of work or other activities:

- o Yes (1)
- o No (2)

6) During the PAST 4 WEEKS, were you limited in the kind of work you do or other regular activities AS A RESULT OF ANY EMOTIONAL PROBLEMS (such as feeling depressed or anxious)? ACCOMPLISHED LESS than you would like:

- o Yes (1)
- o No (2)

7) During the PAST 4 WEEKS, were you limited in the kind of work you do or other regular activities AS A RESULT OF ANY EMOTIONAL PROBLEMS (such as feeling depressed or anxious)? Didn't do work or other activities as CAREFULLY as usual:

- o Yes (1)
- o No (2)

8) During the PAST 4 WEEKS, how much did PAIN interfere with your normal work (including both work outside the home and housework)?

- o Not At All (6)
- o A Little Bit (7)
- o Moderately (8)
- o Quite A Bit (9)
- o Extremely (10)

9) How much of the time during the PAST 4 WEEKS –

	All of the Time (1)	Most of the Time (2)	A Good Bit of the Time (3)	Some of the Time (4)	A Little of the Time (5)	None of the Time (6)
Have you felt calm and peaceful? (9)	o	o	o	o	o	o
Did you have a lot of energy? (10)	o	o	o	o	o	o
Have you felt downhearted and blue? (11)	o	o	o	o	o	o
has your PHYSICAL HEALTH OR EMOTIONAL Problems interfered with your social activities (like visiting with friends, relatives, etc.)? (12)	o	o	o	o	o	o

Demographic information

1) Using numbers, please indicate your age in years (e.g., 25)
2) Please indicate your sex
   - o Male (1)
   - o Female (2)
   - o Transgender (3)
   - o I prefer not to answer (4)
3) Please describe your religious identity or denomination
4) Do you consider yourself to be Hispanic?
   - o YES - Hispanic or Latino (1)
   - o NO - Not Hispanic or Latino (2)
   - o Prefer not to answer (3)
5) Please indicate your race
   - o White or Caucasian (1)
   - o Black or African American (2)
   - o Asian (3)
   - o American Indian or Alaska Native (4)
   - o Native Hawaiian or Other Pacific Islander (5)
   - o Biracial or multiracial (6) ________________________________
   - o Prefer not to answer (7)
6) Please indicate your marital status
   - ▢ never married (1)
   - ▢ married (2)
   - ▢ not married, cohabitating (3)
   - ▢ widowed/widower (4)
   - ▢ divorced (5)
   - ▢ Other (please specify) (6) ____________________
   - ▢ Prefer not to answer (7)

Appendix B

Connectedness to nature factor analysis.

The 14 CNS were subjected to a principal components factor analysis. The analysis yielded three interpretable factors, explaining 67.35% of the variance. Factor one, which accounted for 48.59% of the variance, included 11 items, and broadly related to a feeling of connection: “I often feel a sense of oneness with the natural world around me.”, “I think of the natural world as a community to which I belong.”, “I recognize and appreciate the intelligence of other living organisms.”, “ I often feel disconnected from nature.”, “When I think of my life, I imagine myself to be part of a larger cyclical process of living.”, “I often feel a kinship with animals and plants.”, “I feel as though I belong to the Earth as equally as it belongs to me.”, “I have a deep understanding of how my actions affect the natural world.”, “I often feel part of the web of life.”, “I feel that all inhabitants of Earth, human, and nonhuman, share a common ‘life force’.”, and “Like a tree can be part of a forest, I feel embedded within the broader natural world.”

A second factor, accounting for 9.81% of the variance, was extracted. It included two items tapping into feelings of hierarchy: “When I think of my place on Earth, I consider myself to be a top member of a hierarchy that exists in nature.”, and “I often feel like I am only a small part of the natural world around me, and that I am no more important than the grass on the ground or the birds in the trees.”

A third factor, accounting for 8.95% of the variance, was extracted. It included only one item and assesses the feeling of welfare: “My personal welfare is independent of the welfare of the natural world.”

Appendix C

Connectedness to nature association with spirituality and awe

To ascertain whether CNS was associated with spirituality or awe, Pearson correlations were examined.

Spirituality. The Brief Multidimensional Measure of Religiousness/Spirituality- Daily Spiritual Experiences (1999) was used to index spirituality. Spirituality was examined at DABS-I. The scale consists of 6 items; each scored on 1-Never/Almost Never to 6-Many times a day. Sample items include, “Feel a higher power’s presence” and “Are spiritually touched by the beauty of creation.” Scores on the scale range from 6 – 36, and had a mean of 19.76 (SD = 8.15). A significant positive association emerged between CNS and spirituality ($r(152) = .26$, $p < .01$).

Awe. The Awe Quiz (Adler & Fagley, 2005; Catalino, Algoe, & Fredrickson, 2014; Shiota, Keltner, & John, 2006) was used to examine awe. Awe was examined at DABS-II. The scale consists of 15 items; each scored on 1-Strongly Disagree to 5-Strongly Agree. Sample items include, “When I see someone do something incredible, I feel tingles down my spine” and “I don’t really feel much when I encounter people, art, or scenes in nature that other consider exceptional.” Scores on the scale range from 15-75, and had a mean of 56.93 (SD = 10.27). A significant positive association emerged between CNS and awe ($r(75) = .75$, $p < .01$), consistent with Cowen and Keltner (2017).

Appendix D

Table D1.

Hypothesis 1 and Research question 1, statistics performed, results of analyses, and interpretation

H/RQ number	Hypothesis/Research Question	Statistics	Results	Interpretation
H1A.	Greater CN would be associated with higher positive affect, lower negative affect, and higher life satisfaction.	Pearson *r* correlation	DABS-I: CN sig. pos. with PA DABS-II: CN sig. pos. with SWLS and PA DABS-III: CN sig. pos. with PA	Hypothesis supported
HIB.	Greater CN would be associated with better health outcomes.	Pearson *r* correlation	No significant correlations	Not supported
RQ1A. (Corr.)	No empirical information has been reported regarding whether CN is associated with age	Pearson r correlation	DABS-I: Age sig. pos. associated with CN DABS-II: No sig. association between CN and age DABS-III:No sig. association between CN and age	Equivocal results, but need a larger N in the future
RQ1A. (ANOVA)		1-way Analysis of Variance	DABS-I: CN by age, with older adults higher. DABS-II: No CN by age associations DABS-III: No CN by age associations.	
RQ1B. (Corr.)	Studies assessing gender have found mixed result, therefore the association of gender and CN were examined.	Spearman rho correlation	No significant association between CN and gender	No diff. in CN as a function of gender, but had a wider range of ages.
RQ1B. (ANOVA)		1-way Analysis of Variance	No significant association between CN and gender	
RQ1C. (Corr.)	No research has examined the differences in CN among adults living in different geographical areas.	Spearman rho correlation	DABS-I: No sig. association between CN and location DABS-II: No sig. association between CN and location DABS-III: Location sig. neg. associated with CN	No diff. in CN as a function of location, only at DABS-III
RQ1C. (ANOVA)		1-way Analysis of Variance	No significant association between CN and location	

Table D2.

Examining moderators of the CN to well-being association

Question	Analysis	Results	Interpretation
Analysis examining the main and interaction effects of age and CNS on well-being	Main effects of age and CN, and interaction of CN and age	PA: CN and age uniquely contributed to the variance. NA: No unique contributors to variance SWLS: Age uniquely contributed to the variance SF12: Age uniquely contributed to the variance	Age uniquely contributes to the variance of various well-being factors, in the opposite direction expected for SWLS and PA.
Analysis examining the main and interaction effects of gender and CNS on well-being	Main effects of gender and CN, and interaction of CN and gender	PA: CN uniquely contributed to the variance NA: No unique contributors to variance SWLS: No unique contributors to variance SF12: No unique contributors to variance	Neither gender, nor the interaction of CN and gender contributed to the variance of the well-being factors.
Analysis examining the main and interaction effects of location and CNS on well-being	Main effects of location and CN, and interaction of CN and location	PA: CN and location uniquely contributed to the variance NA: Location and the interaction of CN and location uniquely contributed to the variance SWLS: Location uniquely contributed to the variance SF12: No unique contributors to the variance	Location uniquely contributes to the variance of various well-being factors, with the South showing more positive aspects of well-being compared to the Midwest

Table D3.

Research question 2, statistics performed, results of analyses, and interpretation

H/RQ number	Hypothesis/Research Question	Statistics	Results	Interpretation
RQ2	No specific hypotheses were proposed on the stability or change of CN.	Repeated measures ANOVA	No significant mean differences between the waves of data	CN is stable over time
RQ2		Fisher r-to-z transformation	CN to CN *r* were stable over time	
RQ2		Proposed Latent Growth Curve	Negative variance for CN slope is indicative of no change over time.	
RQ2A	To determine how CN and positive affect change or stay stable together over time, a growth curve model was proposed.	Proposed Multivariate Latent Growth Curve	Analyses couldn't be conducted because of negative slope variance. These analyses are about covariation over time, but negative variance for the CN slope indicates that there is no change over time for CN.	No change over time
RQ2B	To determine how CN and negative affect change or stay stable together over time, a growth curve model was proposed.	Proposed Multivariate Latent Growth Curve	Analyses couldn't be conducted because of negative slope variance. These analyses are about covariation over time, but negative variance for the CN slope indicates that there is no change over time for CN.	No change over time
RQ2C	To determine how CN and life satisfaction change or stay stable together over time, a growth curve model was proposed.	Proposed Multivariate Latent Growth Curve	Analyses couldn't be conducted because of negative slope variance. These analyses are about covariation over time, but negative variance for the CN slope indicates that there is no change over time for CN.	No change over time
RQ2D	To determine how CN and health change or stay stable together over time, a growth curve model was proposed.	Proposed Multivariate Latent Growth Curve	Analyses couldn't be conducted because of negative slope variance. These analyses are about covariation over time, but negative variance for the CN slope indicates that there is no change over time for CN.	No change over time

Table D4.

Research question 2 continued, statistics performed, results of analyses, and interpretation

H/RQ number	Hypothesis/Research Question	Statistics	Results	Interpretation
RQ2 (A,B,C, D)	CN and both emotional and physical well-being will change together over time.	Fisher r-to-z transformation	CN and PA *r* were stable over time. CN and NA *r* were stable over time. CN and SWLS *r* were stable over time. CN and SF12 *r* were stable over time.	Stability between CN and well-being over time
RQ2A	To determine how CN and positive affect change or stay stable together over time	Repeated measures ANOVA	Stability in CN Stability in PA Stability in the relation of CN and PA	Stability in the main effects and their relation to each other
RQ2B	To determine how CN and negative affect change or stay stable together over time	Repeated measures ANOVA	Stability in CN NA is not Stable Stability in the relation of CN and PA	Stability in the main effect of CN but NA is not stable. The relation to each other
RQ2C	To determine how CN and life satisfaction change or stay stable together over time	Repeated measures ANOVA	Stability in CN Stability in SWLS Stability in the relation of CN and SWLS	Stability in the main effects and their relation to each other
RQ2D	To determine how CN and health change or stay stable together over time	Repeated measures ANOVA	Stability in CN Stability in SF12 Stability in the relation of CN and SF12	Stability in the main effects and their relation to each other

Table D5.

Research question 3, statistics performed, results of analyses, and interpretation

H/RQ number	Hypothesis/Research Question	Statistics	Results	Interpretation
RQ3A.	Does age predict the changes in any of the growth curve models between CN and the four constructs of Well-being.	Proposed Multivariate Latent Growth Curve with predictor.	Analyses couldn't be conducted because of negative slope variance. These analyses are about covariation with predictors over time, but negative variance for the CN slope indicates that there is no change over time for CN.	No change over time
RQ3B.	Does gender predict the changes in any of the growth curve models between CN and the four constructs of Well-being.	Proposed Multivariate Latent Growth Curve with predictor.	Analyses couldn't be conducted because of negative slope variance. These analyses are about covariation with predictors over time, but negative variance for the CN slope indicates that there is no change over time for CN.	No change over time
RQ3C	Does participant location predict the changes in any of the growth curve models between CN and the four constructs of Well-being.	Proposed Multivariate Latent Growth Curve with predictor.	Analyses couldn't be conducted because of negative slope variance. These analyses are about covariation with predictors over time, but negative variance for the CN slope indicates that there is no change over time for CN.	No change over time

Table D6.

Research question 3 continued, statistics performed, results of analyses, and interpretation

H/RQ number	Hypothesis/Research Question	Statistics	Results	Interpretation
RQ3A.	Does age predict the change or stability between CN and the four constructs of Well-being.	Repeated measures MANOVA	Age did not uniquely contribute to the stability of CN, and the well-being constructs.	No correlates of stability over time
RQ3B.	Does participant gender predict the change or stability between CN and the four constructs of Well-being.	Repeated measures MANOVA	Gender did not uniquely contribute to the stability of CN, and the well-being constructs.	No correlates of stability over time
RQ3C.	Does location predict the change or stability between CN and the four constructs of Well-being.	Repeated measures MANOVA	Location did not uniquely contribute to the stability of CN, and the well-being constructs.	No correlates of stability over time

Table D7.

Research question 4, statistics performed, results of analyses, and interpretation

H/RQ number	Hypothesis/Research Question	Statistics	Results	Interpretation
RQ4A.	To determine if CN and positive affect predict each other over time.	Cross-lagged path analysis	CN DAB-I sig. pos. predicts CN DABS-II, and II predicts III PA DABS-I sig. pos. predicts PA DABS-II, and II predicts III	Autoregressive paths are significant but no cross-lagged paths are significant.
RQ4B.	To determine if CN and negative affect predict each other over time.	Cross-lagged path analysis	CN DAB-I sig. pos. predicts CN DABS-II, and II predicts III NA DABS-I sig. pos. predicts NA DABS-II, and II predicts III NA DABS-I sig. neg. predicts CN DABS-II, and NA DABS-II sig. pos. predicts CN DABS-III	Autoregressive paths are significant and NA cross-lagged paths are associated with CN.
RQ4C.	To determine if CN and life satisfaction predict each other over time.	Cross-lagged path analysis	CN DAB-I sig. pos. predicts CN DABS-II, and II predicts III SWLS DABS-I sig. pos. predicts SWLS DABS-II, and II predicts III	Autoregressive paths are significant but no cross-lagged paths are significant.
RQ4D.	To determine if CN and health predict each other over time.	Cross-lagged path analysis	CN DAB-I sig. pos. predicts CN DABS-II, and II predicts III SF12 DABS-I sig. pos. predicts SF12 DABS-II, and II predicts III CN DABS-II sig. pos. predicts SF12 DABS-III	Autoregressive paths are significant and CN cross-lagged path is associated with SF12.

Table D8.

Research question 4 continued, statistics performed, results of analyses, and interpretation.

H/RQ number	Hypothesis/Research Question	Statistics	Results	Interpretation
RQ4A.	CN and PA association with age, gender and location as predictors	Cross-lagged path analysis with predictors	Age sig. pos. predicts CN Age sig. neg. predicts PA, and Location sig. pos. predicts PA	Age predicts CN. Age and Location predict PA.
RQ4B.	CN and NA association with age, gender and location as predictors	Cross-lagged path analysis with predictors	Age sig. pos. predicts CN Location sig. neg. predicts NA	Age predicts CN. Location predicts NA.
RQ4C.	CN and SWLS association with age, gender and location as predictors	Cross-lagged path analysis with predictors	Age sig. pos. predicts CN Age sig. neg. predicts SWLS, and Location sig. pos. predicts SWLS	Age predicts CN. Age and Location predict SWLS
RQ4D.	CN and SF12 association with age, gender and location as predictors	Cross-lagged path analysis with predictors	Age sig. pos. predicts CN Age sig. neg. predicts SF12	Age predicts CN. Age predicts SF12

Appendix E

Correlations. The significant correlations between age, gender, location, and well-being factors are examined below. Only significant correlations are discussed here, see Table 4 for all correlations.

Age. Age was significantly negatively associated with SWLS at DABS-I, $r(150) = -20$, $p < .05$, and DABS-II, $r(87) = -.30$, $p < .01$. Age was also significantly negatively associated with PA at DABS-I, $r(150) = .-.18$, $p < .05$. Lastly, age was significantly negatively associated with SF12 at DABS-I, $r(151) = -.40$, $p < .01$, DABS-II, $r(87) = -.52$, $p < .01$, and DABS-III, $r(76) = -.50$, $p < .01$.

Gender. There were no significant associations between gender and the well-being factors. With no significant scores ranging between $r = -.17$ to $r = .10$.

Location. Location, 0 = Midwest and 1 = South, was significantly positively associated with SWLS at DABS-I, ρ (121) = .21, $p < .05$, and DABS-II, ρ (69) = .26, $p < .05$. Meaning that those who lived in the South had higher SWLS and compared to those who lived in the Midwest. Location was also significantly negatively associated with NA at DABS-I, ρ (121) = -.18, $p < .05$. A negative association means that those who lived in the Midwest had higher NA compared to those who lived in the South.

Appendix F

Analyses of Variance. Whether and to what extent age, gender, and location related to well-being factors, mean differences were examined using 1-way Analysis of Variance (ANOVAs).

Age. ANOVAs conducted to examine age differences in SWLS, positive affect (PA), negative affect (NA), and SF12. Participants were categorized as younger adults (Range 18-29, N = 62), middle-aged adults (Range 30-55, N = 66) and late middle-aged to older adults (Range 56- 89, N = 24). Examination of DABS-I show no mean differences in PA as a function of age, F (2, 148) = 1.14, p = .32, nor were mean differences in NA as a function, F (2, 148) = .60, p = .55. For DABS-I there were significant mean differences in SWLS as a function of age, F (2, 148) = 7.83, p = .001. Tukey post-hoc tests showed that younger adults (M = 25.52, SD = 5.44) had significantly higher SWLS compared to middle-aged adults (M = 21.34, SD = 7.01) and late middle-aged to older adults (M = 22.08, SD = 5.07). There were also significant mean differences in SF12 as a function of age, F (2, 149) = 12.78, p = .00. Tukey post-hoc tests showed that late middle-aged to older adults (M = 6.50, SD = 1.01) had significantly lower self-rated health than both young adults (M = 7.34, SD = .37) and middle-aged adults (M = 6.94, SD = .84). Post-hoc tests also showed that middle-aged adults had significantly lower SF12 than younger adults.

For DABS-II, no mean differences emerged as a function of age for: PA (F (2, 84) = .31, p = .73), or NA (F (2, 84) = 1.39, p = .26). For DABS-II there were significant mean differences in SWLS as a function of age, F (2, 84) = 5.93, p = .004. Tukey post-hoc tests showed that late middle-aged to older adults (M = 19.43, SD = 6.03) had significantly lower SWLS compared to both young adults (M = 26.57, SD = 6.11) and middle-aged adults (M= 24.89, SD = 6.74).

Lastly, there were significant mean differences in SF12 as a function of age, F (2, 84) = 21.13, p = .00. Tukey post-hoc tests showed that late middle-aged to older adults (M = 6.16, SD = .86) had significantly lower subjective physical well-being compared to both young adults (M = 7.47, SD = .36) and middle-aged adults (M = 6.98, SD = .67). Post-hoc tests also showed that middle-aged adults have significantly lower SF12 than younger adults.

Lastly, for DABS-III no mean differences emerged as a function of age for: PA (F (2, 74) = .24, p = .79), NA (F (2, 74) = 2.20, p = .12), or SWLS (F (2, 74) = 1.78, p = .18). There were significant mean differences in subjective physical well-being (SF12) as a function of age, F (2, 74) = 8.59, p = .00. Tukey post-hoc tests showed that younger adults (M = 7.32, SD = .39) had significantly higher SF12 ratings than both middle-aged (M = 6.93, SD = .71) and late middle-aged and older adults (M = 6.44, SD = .79).

Gender. ANOVAs were conducted to examine gender group differences in SWLS, positive affect (PA), negative affect (NA), and SF12. At DABS-I, no mean differences emerged as a function of gender: PA (F (1, 148) = 1.51, p = .22), NA (F (1, 148) = .01, p = .92), SWLS (F (1, 148) = .00, p = .99), or SF12 (F (1, 149) = .69, p = .41).

For DABS-II, no mean differences emerged as a function of gender for: PA (F (1, 86) = .29, p = .59), NA (F (1, 86) = .52, p = .48), SWLS (F (1, 86) = .10, p = .75), or subjective physical well-being (SF12; F (1, 86) = 1.04, p = .31).

Lastly, for DABS-III, there were no mean differences as a function of gender for: PA (F (1, 75) = .37, p = .54), NA (F (1, 75) = .42, p = .52), SWLS (F (1, 75) = .14, p = .71), or SF12 (F (1, 75) = .49, p = .49).

Location. Lastly, because of unequal sample sizes, only the participants from the Midwest and South were compared. ANOVAs were conducted to examine location group differences in SWLS, positive affect (PA), negative affect (NA), and SF12. At DABS-I there were no significant mean differences in SF12 as a function of location, F (1, 121) = .00, p = .99. For DABS-I there was a significant mean difference in PA as a function of location, F (1, 119) = 4.71, p = .03, the South (M = 18.64, SD = 2.86) had significantly higher PA than the Midwest (M = 17.47, SD = 2.98). There was a significant mean difference in NA as a function of location, F (1, 119) = 3.93, p = .05, with the South (M = 13.39, SD = 2.58) had significantly lower NA than the Midwest (M = 14.39, SD = 2.92). There was a significant mean difference in SWLS as a function of location, F (1, 119) = 6.40, p = .01, with the South (M = 24.54, SD = 5.44) having significantly higher SWLS than the Midwest (M = 21.73, SD = 6.73).

At DABS-II, no mean differences emerged as a function of location for: PA (F (1, 74) = .01, p = .93), NA (F (1, 74) = .16, p = .69), or SWLS (F (1, 74) = 2.73, p = .10). For DABS-II there was a significant mean difference in SF12 as a function of location, F (1, 74) = 6.15, p = .02, the Midwest (M = 6.76, SD = .83) had significantly lower subjective physical well-being compared to the South (M = 7.18, SD = .60).

Lastly, for DABS-III, no mean differences emerged as a function of location for: PA (F (1, 67) = .16, p = .69), NA (F (1, 67) = .57, p = .45), SWLS (F (1, 67) = .11, p = .74), or SF12 (F (1, 67) = .10, p = .75).

Appendix G

In each of the models, the factor loadings for the intercepts were constrained to 1 to allow for the intercept value to remain constant over time (Bryne, 2010). The factor loadings associated with the slope were constrained to equal 0, 1, and 2, which reflected the time interval between measurements. The model fit parameters were used to determine how well the model fits the data. Model fit was assessed through χ^2 (seeking non-significant values), CMIN/DF (the chi-square statistic divided by the degrees of freedom; below 3.0 is considered a good fit), the RMSEA (provides an index of standard errors; below .08 is considered a good fit) and the CFI (provides an index of parsimony; greater than .9 is considered a good fit), (Little, 2013). Based on model fit, modification indices would be examined to maximize model fit for latent growth models. Once the model fit was determined, beta estimates and covariances would be assessed.

To remedy the issues with negative variances, many strategies were examined. The data were reexamined to determine if coding errors were present and all data was downloaded again from the original source and recoded. Once the data were recoded and reexamined the negative variance was still present, so further measures were assessed to try and alleviate the negative variance. Although the data did not show extreme skew or kurtosis, it has been suggested that skewed data (with floor or ceiling effects) may affect the variance (Kolenikov & Bollen, 2012), therefore data were square root transformed, but negative variance persisted. It has also been suggested that having too much missingness and therefore a large number of values being imputed may contribute to a negative variance (Wothke, 1993). The technique of maximum likelihood estimation to impute missing values uses all available data to estimate the parameters (Little, 2013), this means that many people had no slope because the imputed numbers were based on their previous responses. Lastly, only participants who completed all three waves of the data were assessed, but the negative variance for the slopes persisted. Negative variance may have persisted in the sample who completed all three waves of data (N = 63) because of a relatively small sample size (Okada, 2017). Because negative variance cannot be interpreted no further latent growth models were examined.

Appendix H

For the two constructs that didn't have negative variance, SWLS and SF12, it was found that SWLS had adequate model fit, $\chi^2(3, N = 162) = 4.04$, $p = .26$, CMIN/DF = 1.35 , CFI = .99, and RMSEA =.05. For life satisfaction, the intercept = 23.25 was significant ($p < .01$), meaning that the average starting point is different than 0. The slope = .43 was not significant ($p = .15$). For the covariance of the intercept and slope there was no significant covariance (Estimate = 1.57, $p = .48$). Lastly, there was a significant variance of the intercept = 28.23 ($p < .01$), which means that people significantly start their SWLS in different places, but the variance for slope = 1.27 ($p = .46$) was not significant, which means that people's change in SWLS does not significantly vary by person.

It was also found that the growth curve for the SF12 had adequate model fit, $\chi^2(3, N = 168) = 6.33$, $p = .10$, CMIN/DF = 2.11 , CFI = .98, and RMSEA =.08. For subjective physical well-being, the intercept = 7.02 was significant ($p < .01$), meaning that the average starting point is different than 0. The slope = -.05 was not significant ($p = .10$). For the covariance of the intercept and slope there was no significant covariance (Estimate = -.001, $p = .93$). Lastly, there was a significant variance of the intercept = .45 ($p < .01$), which means that people significantly vary in their starting point of SF12, but the variance for slope = .009 ($p = .65$) was not significant, which means that people's change in SF12 does not significantly vary by person.

Appendix I

RQ4: Longitudinal research question; assessing prediction over time.

RQ4A. In the cross-lagged path analysis examining the association between CN and PA with age, location, and gender as predictors, the model had poor fit, $\chi^2(22, N = 152) = 88.23$, $p = .00$. Age ($\beta = .15$, $p = .06$), location ($\beta = -.07$, $p = .43$), nor gender ($\beta = -.02$, $p = .83$) were significantly associated with CN. Nor were age ($\beta = -.14$, $p = .09$), location ($\beta = .16$, $p = .08$), gender ($\beta = -.09$, $p = .27$), associated with PA, see Figure I1 for full model with all regression weights.

RQ4B. In the cross-lagged path analysis examining the association between CN and NA with age, location, and gender as predictors, the model had poor fit, $\chi^2(22, N = 152) = 52.81$, $p = .00$. Age ($\beta = -.01$, $p = .94$), and gender ($\beta = .01$, $p = .86$) were not significantly associated with NA. But location was significantly associated with NA ($\beta = -.20$, $p = .03$), see Figure I2 for full model with all regression weights.

RQ4C. In the cross-lagged path analysis examining the association between CN and life satisfaction with age, location, and gender as a predictors, the model had poor fit, $\chi^2(22, N = 152) = 60.92$, $p = .00$. Gender ($\beta = .02$, $p = .84$) was not significantly associated with life satisfaction. But age ($\beta = -.16$, $p = .04$), and location ($\beta = .19$, $p = .03$) were significantly associated with life satisfaction, see Figure I3 for full model with all regression weights.

RQ4D. In the cross-lagged path analysis examining the association between CN and physical health with age, location, and gender as a predictors, the model had a poor fit, $\chi^2(22, N = 152) = 72.46$, $p = .00$. Location ($\beta = -.09$, $p = .30$) and gender ($\beta = -.02$, $p = .82$) were not significantly associated with physical health. But age ($\beta = -.41$, $p < .001$) was significantly associated with physical health, see Figure I4 for full model with all regression weights.

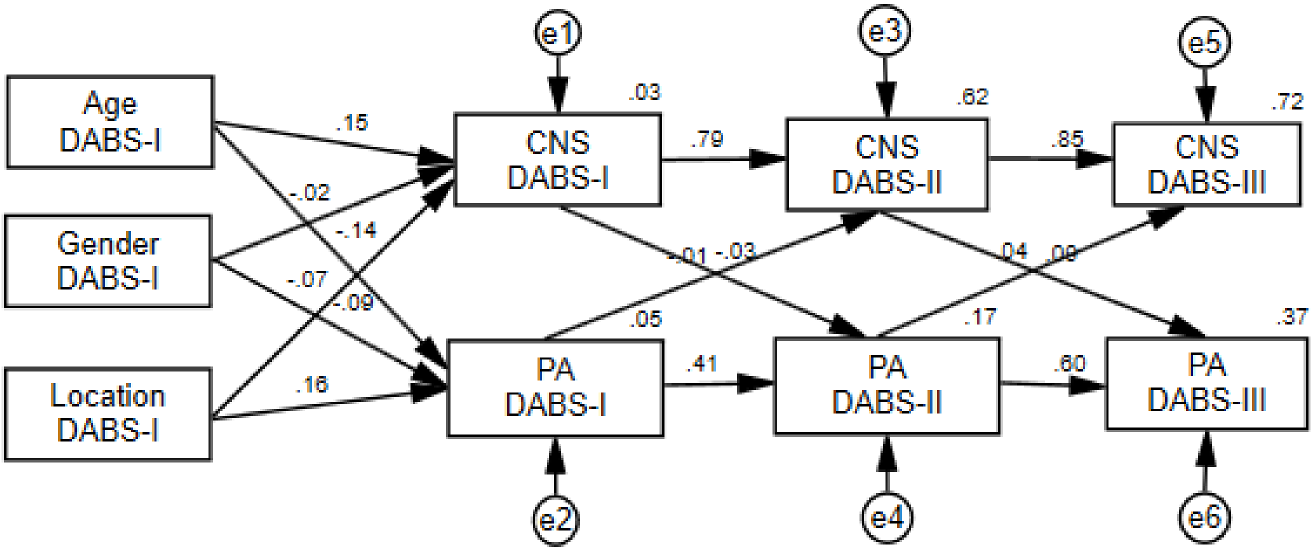

Figure I1. Cross-lagged path analysis, with standardized regression weights, for connectedness to nature and positive affect with age, gender (0 = female, 1 = male), and location (0 = Midwest, 1 = South) as covariates.

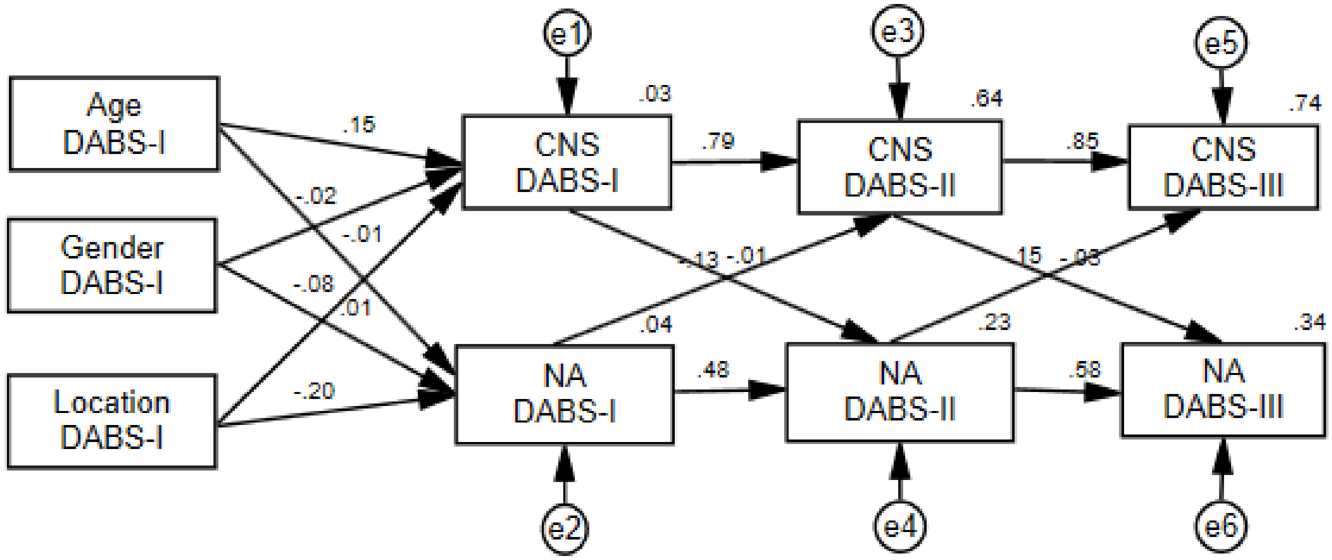

Figure I2. Cross-lagged path analysis, with standardized regression weights, for connectedness to nature and negative affect with age, gender (0 = female, 1 = male), and location (0 = Midwest, 1 = South) as covariates.

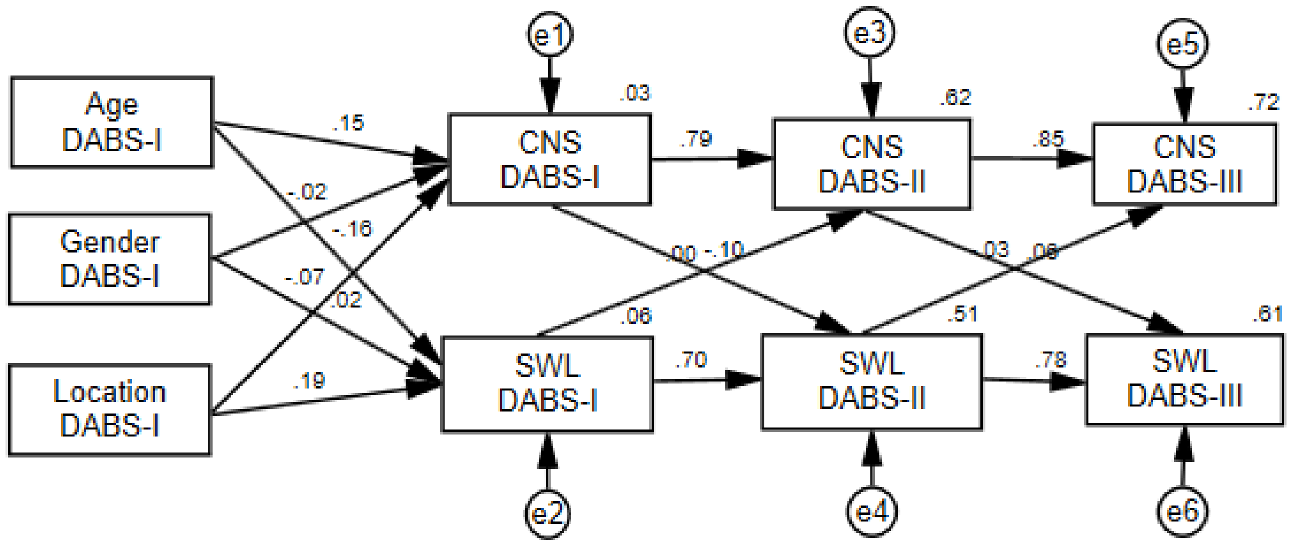

Figure I3. Cross-lagged path analysis, with standardized regression weights, for connectedness to nature and life satisfaction with age, gender (0 = female, 1 = male), and location (0 = Midwest, 1 = South) as covariates.

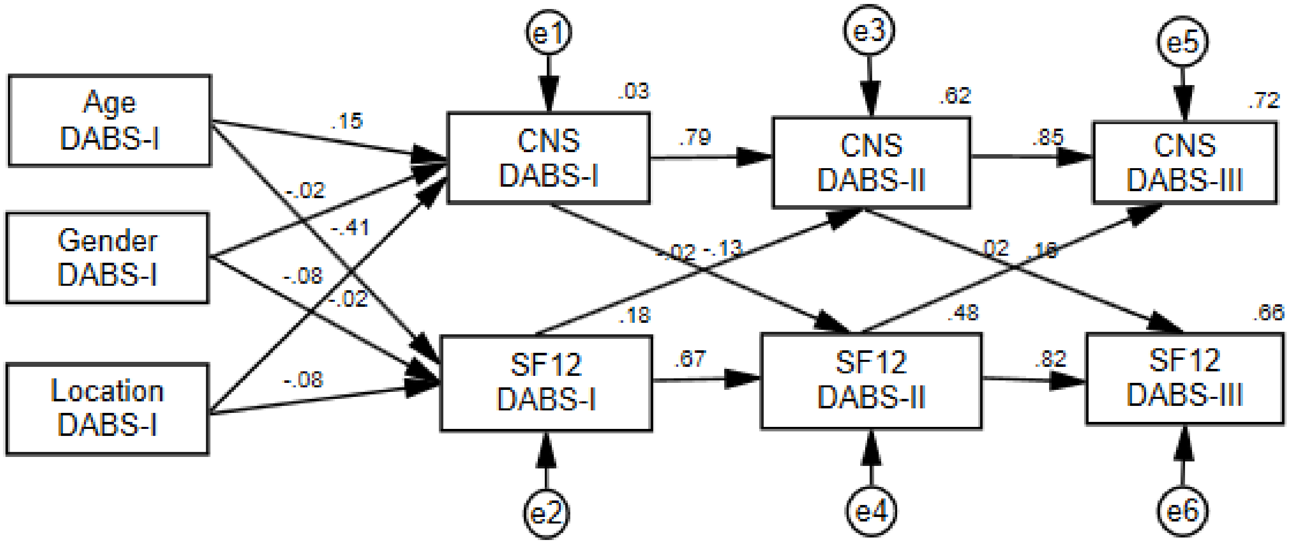

Figure I4. Cross-lagged path analysis, with standardized regression weights, for connectedness to nature and subjective physical well-being with age, gender (0 = female, 1 = male), and location (0 = Midwest, 1 = South) as covariates.

Appendix J

Analyses of Variance (ANOVAs) were conducted for rural/urban X CN, rural/urban X SWLS, rural/urban X PA, rural/urban X NA, and rural/urban X SF12 for each wave of data. For DABS-I, there were 50 (32.9%) participants who were classified as living in rural, and 102 (67.1%) participants classified as living in an urban area. For DABS-I, there were no significant differences for CN by rural/urban, F (1, 143) = .81, p = .37, nor were there significant differences in PA by rural/urban, F (1, 143) = .03, p = .86, nor were there significant differences in NA by rural/urban, F (1, 143) = .05, p = .82, nor were there significant differences in SWLS by rural/urban, F (1, 143) = .86, p = .36, nor were there significant differences in subjective physical well-being by rural/urban, F (1, 144) = .50, p = .48.

For DABS-II, there were 32 (32.7%) participants who were classified as living in rural, and 66 (67.3%) participants classified as living in an urban area. For DABS-II, there were no significant differences for CN by rural/urban, F (1, 94) = 2.37, p = .13, nor were there significant differences for NA by rural/urban, F (1, 95) = 1.10, p = .30 nor were there significant differences for SWLS by rural/urban, F (1, 95) = 1.09, p = .30, nor were there significant differences for subjective physical well-being by rural/urban, F (1, 95) = 1.25, p = .27. For DABS-II, there were significant differences for PA by rural/urban, F (1, 95) = 5.62, p = .02, with urban participants (M = 18.11, SD = 3.33) having significantly higher PA than rural participants (M = 16.29, SD = 3.89).

Lastly, for DABS-III, there were 27 (31.8%) participants who were classified as living in rural, and 58 (68.2%) participants classified as living in an urban area. For DABS-III, there were no significant differences for CN by rural/urban, F (1, 81) = .22, p = .64, nor were there significant differences for PA by rural/urban, F (1, 83) = 1.38, p = .24, nor were there significant differences for NA by rural/urban, $F(1, 83) = .05$, $p = .82$, nor were there significant differences for SWLS by rural/urban, $F(1, 83) = 2.72$, $p = .10$, nor were there significant differences in subjective physical well-being by rural/urban, $F(1, 83) = 1.56$, $p = .22$.